Katharina Wratschko

Strategic Orientation and Alliance Portfolio Configuration

The Interdependence of Strategy and Alliance Portfolio Management

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With a foreword by Prof. Dr. Gerhard Speckbacher

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Foreword

Strategic management research is about explaining why some firms continuously outperform others. Recent research has been focusing on the study of alliances as vehicles to boost competitive – or better: collaborative – advantage. Moving beyond the dyadic level, corporate networks have become a very popular field of research. Whereas a lot of research has already been done on costs and benefits of networks, little has been said about the alignment of network configuration (e.g. the mix of strong and weak ties or the quantity and diversity of ties) and strategic orientation. Since different network configurations bring about distinct benefits for the collaborating partners, the fit between strategic goals and network configuration influences whether and how value is generated on a firm and dyadic level.

Katharina Wratschko combines Transaction Cost Theory and Resource Based Theory with Social Network Theory to analyze this question theoretically. Her ambitious work reveals important insights on how focal firms build and design their alliance networks to match their strategic resource needs. Based on a sound theoretical analysis she develops a set of hypotheses which are empirically tested using data from the pharmaceutical industry.

The quality of insights and results derived from this work prove that Katharina Wratschko is not only a highly dedicated but also a very inspiring researcher. As a colleague at the Institute for Strategic Management and Management Control she inspired all of us to view matters from a network perspective. It is obvious that Katharina's research has also benefitted from her discussions with excellent students and from her own practical experience derived from various business projects on network analysis and network design conducted together with leading international corporate partners at the Institute for Strategic Management and Management Control. The combination of high quality research, teaching and practical application in business projects is the core of our Institute's "philosophy" and this book is an excellent example for the fruitfulness of such an approach.

As a consequence, I believe this work is not only of great interest for all researchers and PhD students in the field of strategic management. It is also highly valuable for practitioners who have to manage multiple collaborations with other firms.

Univ. Prof. Dr. Gerhard Speckbacher

Acknowledgments

"Networking is a fashionable topic", as Jarillo (1988) observed in his popular article "On strategic networks" almost two decades ago. This comment was very forward-looking indeed, as the general interest in alliances and networks has not ceased since. More than ever before, scholars and practitioners alike are keen to find solutions to the manifold challenges of today's networked business environment.

When I started my doctoral program and my engagement as a research and teaching assistant at the Vienna University of Economics and Business Administration in fall 2003, I was almost immediately infected by the "network virus". I was inspired by the seminal work of Ranjay Gulati, Jeffrey Dyer, Habir Singh, Gautam Ahuja, Steven Borgatti, Walter Powell and many more. I also had the chance to discuss my ideas with Werner Hoffmann, who inspired me to further explore the theories explaining network phenomena. At the same time, I was able to discuss my thoughts with practitioners during several business projects that were realized together with students, faculty and corporate partners. Being involved in teaching, projects and research at the same time had advantages as well as drawbacks. On the one hand, the process was very time-consuming and sometimes quite frustrating. On the other hand, it was very fascinating and fruitful to discuss my ideas with "both worlds", i.e. executives and academics alike.

I want to thank my colleagues at the Institute for Strategic Management and Management Control (IFU) for being not only colleagues, but friends, without whom I would have given up long before. A special thank you goes to Raoul Ruthner, Gregor Gossy, Andrea Iro and Johanna Meyer-Wolfbauer for their lasting friendship and support in good and bad times. I want to thank Leopoldine Aigner for her supportive words and for helping me out so many times in all kinds of matters. I want to thank Isabella Grabner, Pia Offenberger and Andreas Feichter, for being supportive and encouraging during the last months of my dissertation, when they often didn't see much of me except the top of my head behind the screen. I am especially grateful to my supervisor and Department Chair, Gerhard Speckbacher, for giving me the freedom to develop, discuss and present my research both at home and at international conferences. I acknowledge his trust in my work and his continuous support of my plans. Without him, I would not have been able to stay at The Wharton School as visiting scholar, where I made critical progress in my research project. A big thank you goes to Ron Meyer for supporting my application to The Wharton School. The tribute goes also to the Rector's Council, especially to Barbara Sporn and

Karl Sandner, who supported my research stay abroad. I want to thank Bodo Schlegelmilch, my second supervisor, and his team at the Department of International Management for the opportunity to discuss the topic of strategic alliances across departments and disciplines.

A big thank you goes to the faculty and staff at the Sol. C. Snider Entrepreneurial Research Center, The Wharton School, University of Pennsylvania, who provided me with an excellent research environment during my stay in spring 2006. I want to thank Roz Cohen for all her friendly and essential support. I gratefully acknowledge the huge support of Ian MacMillan, who not only gave me essential feedback to my research but also got me in contact with other faculty and industry experts. I am very grateful to Roger Longman, Managing Partner at Windhover Information Inc., and his team for their support, which lay the foundations for the empirical part of my dissertation. I was granted access to the Windhover SIS database, the main source of high quality alliance data. A big thank you goes to the executives who were willing to share their expertise and industry experience, above all to Gary Kaplanovich, Director of Finance, Strategic Business Analysis at Sanofi Aventis. I also want to thank the faculty of the Management Department of The Wharton School, especially Katherine Klein for her wonderful class, her friendly support and her critical feedback on my papers. I want to thank Ulrich Wassmer for many interesting discussions ever since we met, and for motivating me to apply for the visiting scholarship. A big thank you goes to my fellow visiting scholars and friends Martin Ihrig, Marcel Tyrell, Baris Serifsoy, Daniele Foschini, Lukas Schmid and Chiara Biagini.

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Most I owe to my family and friends. Thank you for your understanding during all those years when I spent endless evenings and weekends reading and writing.

Dr. Katharina Wratschko

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Introduction

Alliance networks are recognized by both strategy researchers and practitioners as important drivers of firm performance and network studies have become an integral part of strategic management research in the past decade (Borgatti and Foster, 2003; Brass, et al., 2004; Gulati, 1998; Gulati, Nohria and Zaheer, 2000). Empirical studies generally show a positive relationship between network embeddedness and focal firm performance (Baum, Calabrese and Silverman, 2000; Lee, Ch., Lee and Pennings, 2001; Soda and Zaheer, 2004). Management literature typically conceptualizes inter-organizational relationships as an alternative organizational form (between market and hierarchy) and as an essential means of strategy implementation (Das and Teng, 2000; Hoskisson, Hitt and Wan, 1999). Especially in fast-moving industries, companies draw increasingly on partner resources to accomplish their strategic goals. Entire industries are re-defined as companies decentralize and value-creating activities are carried out by, or together with, alliance partners.

In the past decades, focus has gradually shifted from individual dyadic relationships to the study of alliance portfolios (Anand and Khanna, 2000: 1280; Bamford and Ernst, 2002; Doz and Hamel, 1998; Gomez-Casseres, 1994) and alliance networks (Gulati, 1998; Gulati, et al., 2000; Jarillo, 1988). Strategic alliances are defined as "…voluntary arrangements between firms involving exchange, sharing, or co-development of products, technologies, or services" (Gulati, 1998: 293). This definition includes joint ventures and other equity alliances and refers to arrangements between two or more independent firms. The term "*dyadic* alliance" refers to bilateral arrangements only. The entire set of a company's strategic alliances is typically referred to as alliance portfolio or alliance network, although the term alliance network may also refer to a larger group of interconnected firms where borders can hardly be defined.[1]

Why is it important to consider the entire alliance portfolio as opposed to looking at the partnerships one by one? As the number of a firm's strategic alliances increases, synergies and also conflicting demands arise (Bamford and Ernst, 2002; George, et al., 2001; Gulati, 1998; Hoffmann, 2005). By developing an integrative alliance strategy, a firm's resource management can be better and more actively aligned with its overall strategic goals. I conceptualize alliances as "tools" for resource management, which includes obtaining resources (e.g. through licensing

[1] Please see chapter 3.1 for definitions of key terms used in the context of alliances and networks.

agreements or joint development) and sharing internal resources with partners (e.g. out-licensing or providing services for a partner firm). From a resource-based perspective, strategic alliances can be seen both as access to competitive external resources and as opportunity to use under-utilized internal resources (Das and Teng, 2000). Interorganizational relationships can even be seen as valuable resources themselves and as locus of innovation and value creation (Ahuja, 2000a; Dyer and Singh, 1998). In this light, managing the alliance portfolio actually means managing a large part of a firm's resources. The alliance portfolio should be designed to meet the company's short and long term strategic resource needs and should support the overall business strategy.

An impressive body of research has dealt with various issues concerning alliance networks and the causes and effects of network embeddedness. A large number of studies have focused on the performance-enhancing effect of alliance networks (Baum, et al., 2000; Kale, Dyer and Singh, 2002; Kim and Park, 2002; Lee, Ch., et al., 2001; Powell, et al., 1999; Stuart, 2000; Zaheer and Bell, 2005). Viewer studies have studied alliance network characteristics (George, et al., 2001; Lavie, 2004) or have tried to conceptualize and measure a firm's network resources along several dimensions (Koka and Prescott, 2002). Empirical evidence on the performance-enhancing effect of network embeddedness has shown mixed and often contradicting results as to which "type" of network is optimal. Therefore, scholars have increasingly tried to identify contingencies that determine the situation-specific usefulness of certain network characteristics (e.g. number, quality and diversity of relationships.). Although contingency theory originally focuses on the fit between organizational structure and contingencies like environmental factors or aspects of strategy (Burns and Stalker 1961, Chandler 1962, Donaldson 2001), attempts have been made to employ the approach in the network context. Contingency factors that have been used in empirical alliance studies include market conditions (Gulati and Higgins 2003), firm nationality (Koka and Prescott 2002), organizational structure (Geletkanycz, Boyd and Finkelstein 2001), growth stage (Hite and Hesterley 2001) and industry dynamics (Rowley et al. 2000). Hite and Hesterly (2001), for example, address the question whether cohesive or sparse networks lead to success, depending on the growth stage of the firm. Rowley et al. (2000) provide some evidence that optimal network configuration varies across industries. Dynamic industries call for large, sparse networks, whereas stable, saturated industries require dense networks with a small and stable set of partners.

Despite of growing empirical evidence of the strategic importance of alliance networks, the role of a firm's business strategy for building effective networks has hardly been studied (Ahuja, 2000a). More specifically, existing studies are limited in two main aspects: First, conceptualization and measurement of a firm's network resources is poor and often captured by only structural characteristics such as the number of ties or structural holes. Second, insufficient attention has been paid to intra-industry heterogeneity. While the concept of strategic groups is well recognized in the management literature, the influence of strategic group membership on the configuration of the alliance portfolio has largely been neglected. As each strategy has distinct resource requirements, firms should align their alliance portfolios with their specific strategic resource needs. One size never fits all.

This research addresses the above identified gap and sheds light on the complex relationship between a firm's business strategy and its alliance portfolio. A firm's business strategy will be conceptualized by drawing on Miles and Snow's (1978) and Zammuto's (1988) integrative strategic typologies, which have shown that firms can broadly be classified into groups according to their main strategic orientation. A firm's alliance network will be conceptualized as network resources, or social capital of the organization, which can be characterized by network size, average tie strength and network diversity.

In the theoretical part, I will first present the state-of-the art concepts and studies in alliance and network research. Next, I will briefly outline the basics of research in organizational configurations. Finally, I will develop my hypotheses concerning the relationship between business strategy and alliance portfolio characteristics. In the empirical part, I will first describe the pharmaceutical industry as empirical setting. Next, I will present the methods to be used in this study. Then, I will perform a cluster analysis to group sample firms according to their strategies followed by a comparison of mean values of network characteristics across groups. Finally, I will compare mean values of network characteristics across strategic groups by using ANOVA (=analysis of variance) and MANOVA (= multiple analysis of variance).

1 Theoretical underpinnings of alliance and network research

Inter-organizational relationships of all kinds, particularly strategic alliances and networks, have become a central topic in strategic management. From its very origins, strategy research has "borrowed" from various disciplines like economics, organization theory, management theories and sociology (Hoskisson, et al., 1999). Likewise, scholars from different backgrounds have drawn on many different theories to study alliances and networks. The use of a particular theory to study alliances and networks highly affects the way they are conceptualized and depends primarily on the purpose of the study.

Following Gulati (1998), and for the purposes of this theoretical analysis, I define strategic alliances as "…voluntary arrangements between firms involving exchange, sharing, or co-development of products, technologies or services" (Gulati, 1998: 293). This definition includes joint ventures and other equity alliances. The term "strategic" reflects the focus on "long-term, purposeful arrangements" with an end to achieving sustained competitive advantage for the parties involved (Jarillo, 1988: 32). In this literature review I use the term "alliance" for dyadic alliances and the term "alliance network" in a wider sense for both alliance portfolios and larger alliance networks. Key terms used for theory development later on will be defined in chapter 3.1.

The aim of this chapter is to evaluate the dominant theories in the field of strategic alliances and networks, i.e. transaction cost economics, the resource-based view and social network theory. More specifically, I will focus on the theories' ability to explain i) formation of alliances and networks and ii) value creation in alliances and networks. "Formation" encompasses decision making, partner selection and contract closing. When looking at value creation in alliances and networks, I will look at both value creation and value appropriation. "Value creation" refers to any improvement of the focal firm's competitive position. Therefore, both factors that drive value creation (e.g. complementary resources) and factors that mitigate negative consequences of opportunism (and thus a loss of appropriable quasi-rent) have to be considered. Contradictions within and across theories as well as promising attempts to reconcile different perspectives will be discussed at the end of this review in chapter 1.5.

Prior to my decision to select these three theories for my review, I analyzed articles published in the Administrative Science Quarterly, the Academy of Management Journal, the Academy of Management Review, the Strategic Management Journal and Organization Science during the last decade. Then, I made my decision for two major reasons: First - despite their very different

original purposes - all three theories have found their way into mainstream strategy research and have been applied by scholars from various backgrounds to study alliances and networks. Second, they all have made efforts to explain causes and consequences of inter-organizational relationships – or, put differently: they all seek to explain why alliances are formed and/or how they contribute to a better performance of the partner firms.

In order to give an answer to these questions in a structured manner, I will follow the same order of analysis with every theory (see Figure 1): First, I will briefly outline the origins and basic concepts of the respective theory. Second, I will look at the theory's explanation for alliance and network formation. Third, I will focus on the respective theories' logic of value creation in alliances and networks. Finally, I will review multi-theory concepts in alliance research and discuss synergies and differences between different theoretical approaches. I will also discuss and evaluate the appropriateness of each theory for different research areas.

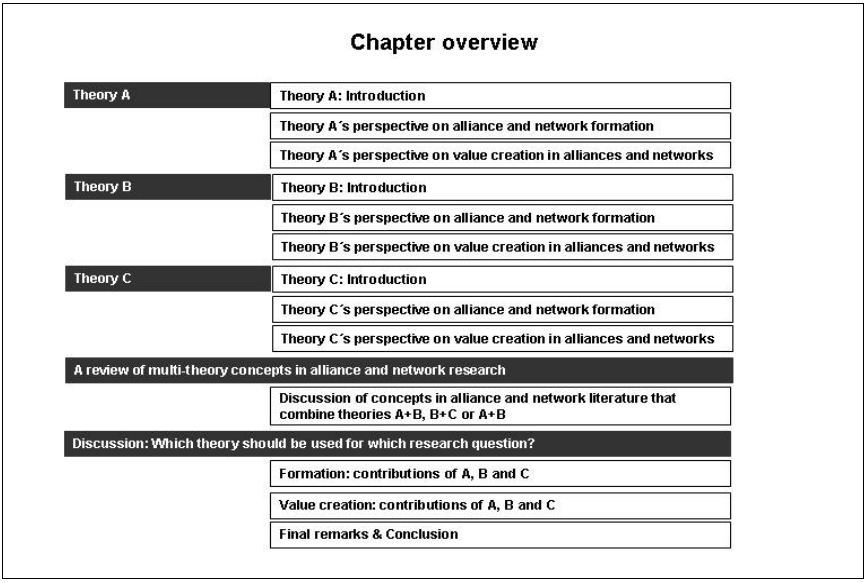

Figure 1: Chapter overview – Theoretical underpinnings.

1.1 A critical assessment of TCE's contribution to alliance and network research

Out of the three theories discussed in this paper, transaction cost theory (TCT) is the most "economic" approach to analyzing inter-organizational relationships. Together with contract law

and property rights theory, it forms part of organizational economics or what is referred to as "new institutional economics". Transaction cost economics has been widely used to study make-or-buy decisions (for excellent reviews see David and Han, 2004; Klein, P., 2004), often in combination with the resource-based view (Combs and Ketchen, 1999; Leiblein and Miller, 2003; Madhok and Tallman, 1998). It is not my intent to review the impressive literature already available, but rather to point to its contribution to explaining alliance formation and value creation.

1.1.1 An introduction to transaction cost theory

In his seminal article „The nature of the firm", Coase (1937) first found an answer to the question of why organizations exist. Whenever the costs of managing exchange across markets outweigh the costs of organizing the activity internally, firms are more efficient vehicles to manage economic exchange than markets. Therefore, an organization will grow until the marginal costs of integrating an activity equal the costs of using the market mechanism (Coase, 1937: 395). Costs of using the market include search costs, negotiating contracts, renegotiations, inspections and settling disputes. Hierarchies, on the other hand, involve the costs of setting up and maintaining the organization, bureaucratic inefficiencies, lack of incentives and centralized decision making (Barney and Hesterley, 1996: 116; Erlei, Eschke and Sauerland, 1999: 184-187). By putting transaction costs at the centre of organizational analysis, Coase established the foundations of transaction cost theory.

In contrast to the neoclassical model of rational actors, transaction cost economics builds on the general assumption of "bounded rationality" (Richter and Furubotn, 1999: 4; Simon, 1961: 14). Moreover, Williamson's (1985) transaction cost theory holds that human beings generally act – or may act - opportunistically, whereby he defines opportunism as the pursuit of self-interest "with guile". It may thus be too costly to write complete contracts as all contingencies cannot be foreseen. The hold-up problem involved with incomplete contracting bears the risk of underinvestment unless the activity is integrated, that is carried out under hierarchical governance, as adversarial interests are mitigated though integration (see e.g. Dilger, Frick and Speckbacher, 1999: 27; Klein, P., 2004: 437).

Transaction cost theory provides us with a framework for linking transaction types to certain modes of coordinating economic activity (Williamson, 1994). The ultimate aim is to minimize

transaction costs by choosing the governance mode which best fits the contingencies. According to Williamson (1985), transactions will be coordinated by different governance systems (markets, hierarchies, or hybrids) depending on factor specificity, uncertainty, and frequency of the underlying transaction. Networks obviously fall into the wide category of hybrids. Whereas initially the emphasis lay on the "pure" organizational forms, market and hierarchy, focus shifted to hybrids in the early 1990ies. Williamson himself wrote (1985: 83) "Whereas I was earlier of the view that transactions of the middle kind were very difficult to organize and hence were unstable, …, I am now persuaded that transactions in the middle range are much more common." Only a few years later, transaction cost economics turned into an empirical research program and was used by scholars with backgrounds as diverse as economics, strategy, and sociology (for an excellent review see Ménard, 2004). The main implications of empirical studies on the make-or-buy decision will be presented in the following chapter. Literature that combines transaction cost theory with social theories will be discussed in chapter 1.4.1.

1.1.2 A transaction cost perspective on alliance and network formation

According to transaction cost economics, governance should be aligned with transactional characteristics, namely asset specificity, frequency, and uncertainty (Williamson, 1985). Strategic alliances are perceived as hybrids between market and hierarchy and thus represent a highly flexible mode of governance. According to transaction cost theory, market mechanisms should be used if assets are commodities, that is not specific at all. Activities should be integrated or carried out in house if asset specificity and frequency are high. Consequently, hybrids are the appropriate form of governance in the case of fairly frequent transactions and medium asset specificity (Williamson, 1985: 89). The asset specificity of a transaction is arguably the most influential of all criteria used and refers to the degree to which the assets can be redeployed to "…alternative uses and by alternative users without sacrifice of productive value" (Williamson, 1991b: 282). Generally speaking, as asset specificity increases, hybrids and hierarchies will be preferred over markets. The effect of uncertainty on governance choice, however, depends on the level of asset specificity. If asset specificity is low, markets are preferred regardless of the level of uncertainty. If asset specificity is present to a nontrivial degree, increases in uncertainty increase the relative attractiveness of both hierarchies and hybrids (Williamson, 1985: 79). When both asset specificity and uncertainty are high, hybrids become less attractive and hierarchies become the optimal governance mode (David and Han, 2004: 41). Although uncertainty reduces the efficiency of all competing governance mechanisms, it specifically disturbs hybrid governance,

because “hybrid adaptations cannot be made unilaterally (as with market governance) or by fiat (as with hierarchy) but require mutual consent. Consent, however, takes time.” (Williamson, 1991b: 291). Consequently, an increase in uncertainty would shift the cost curve of hybrids upward until the point where hybrid organization becomes entirely inefficient.

Broadly speaking, transaction cost economics sees vertical integration as an efficient means of protecting relationship-specific investments under the assumption of incomplete contracts. Since the 1970s, an impressive amount of transaction-cost based empirical studies on the “make-or-buy decision” has been published (for an extensive review see Klein, P., 2004). The likelihood of observing a particular mode of governance is seen as a function of transactional characteristics. The organizational form thus serves as dependent variable, while the transactional characteristics are independent variables. Traditionally, the actual governance choice was assumed to be the most efficient alternative and the actual performances of organizations were not studied. Only recently, researchers have begun to account for performance differences by endogenizing both organizational form and performance (Klein, B., Crawford and Alchian, 1978: 441). This trend seems promising as it allows us to assess the actual performance impact of matching governance mode to transactional characteristics. (Klein, P., 2004).

In explaining the formation of alliances and networks, however, transaction cost theory is limited in at least two ways: First, it does not account for the additional value created through inter-organizational relationships. If parties involved only focused on the minimization of transaction costs, they would miss out the potential of maximizing the relational rent generated through access to the partner’s resources and capabilities. Thus, the expected joint value created might outweigh transaction cost considerations (Dyer and Singh, 1998; Zajac and Olsen, 1993). Second, transaction cost theory focuses on the dyadic relationship, treating each transaction as an event independent of its embeddedness in a much broader network of relationships. By implementing informal governance mechanisms (such as reputation and trust), governance costs can be lowered (Dyer and Singh, 1998; Spremann, 1990; Zajac and Olsen, 1993).

1.1.3 A transaction cost perspective on value creation in alliances and networks

As described in the previous chapter, transaction cost economics traditionally doesn’t focus on value creation, but much rather on cost reduction. Nevertheless, it provides us with clear-cut recommendations on how to enhance rent generation and thus performance through efficient and

effective governance choices. Essentially, there are two dimensions to be considered by management. First, the decision to form a strategic alliance should be based on transaction-cost theory (see chapter 1.1.2). Second, once an alliance has been established, attention should be given to balancing relation-specific investments and thus inter-dependencies between partners, as these specific assets are the core of value creation in alliances. In the following, the second dimension will be discussed in greater detail.

Transaction-specific resources (and rents) derive from co-specialization of the partner's assets (Madhok and Tallman, 1998; Peteraf, 1993). Williamson (1985) identifies three types of asset specificity: site specificity, physical asset specificity, and human asset specificity. If a supplier customizes machinery to a key-customer's need, builds the production plant close to the customer and even trains its employees for the specific technology necessary to operate the customized machines, all three types of specificity can be observed. Value creation along the value chain is only possible if alliance partners are willing to make transaction-specific investments (Williamson, 1985). An invested asset is transaction-specific if its value diminishes when used outside of the relationship. "The quasi rent value of the asset is the excess of its value over its salvage value, that is, its value in its next best use to another renter" (Klein, B., et al., 1978: 298). Put differently, the "quasi rent" is the value that gets lost if the resource is applied to its next best use (Alchian and Demsetz, 1972: 298). Madhok and Tallman (1998: 329) stress that the value created in strategic alliances stems both from transaction-specific rents *and* firm-specific rents. Relational rents (or collaboration-specific rents, as Madhok and Tallman, 1998, refer to them) accrue to an alliance if both firm-specific assets *and* transaction-specific assets are combined to create value above the sum of the rents accomplishable by the partners without the alliance. Value creation in alliances can thus best be explained by combining transaction cost economics and the resource-based view (see discussion of the relational view in chapter 1.4.2).

Partner-specific investments will only be made if the risk of opportunism can be minimized, that is if efficient governance mechanisms are put in place. Apart from using contracts (which are not sufficient in complex relationships as it is impossible to foresee all contingencies), interorganizational alliances can be governed by formal and informal self-enforcing mechanisms. Formal safeguards include e.g. credible commitments such as shared investments and equity cross-holdings (Williamson, 1983: 522). Informal arrangements are arguably the most efficient means to foster relation-specific investments and include trust and reputation (Dyer and Singh, 1998: 671; Gulati, 1995b: 93). These "soft" mechanisms are highly path-dependent and difficult

to imitate and thus provide a solid basis for competitive advantage. Apart from being a relatively "cheap" governance mechanism, trust has additional value-creating potential as it fosters knowledge exchange and innovation (Dyer and Singh, 1998: 670; Zajac and Olsen, 1993).

The essence of this chapter can thus be described as follows. An entrepreneur or manager should consider the total value of her make-or-buy decision. An activity should be carried out via strategic alliance if the sum of external costs (that is the costs of sourcing from the supplier) plus the transactions costs (e.g. search costs and governance costs) are lower than the costs of carrying out the activity internally (external cost + transaction cost < internal cost) (Jarillo, 1988: 35). If a significant amount of transaction-specific investments is involved, this will only be the case if transaction costs can be reduced by building trust with your partner.

Transaction cost theory focuses on dyadic relationships and thus doesn't give any recommendations for networks apart from what it implies in dyadic relationships. In other words, transaction cost theory treats inter-organizational relationships on a one-by-one basis and can hardly account for interdependencies and network effects (see also Gulati, 1995a).

1.2 A critical assessment of the RBV's contribution to alliance and network research

Since the late 1980s, the resource-based view (RBV) has become one of the most influential theoretical streams in strategy research. Although traditional resource-based logic assumes that strategic resources rest within firm boundaries, the RBV has recently been applied to the study of strategic alliances and networks. The aim of this chapter is to assess the resource-based view's contribution to alliance and network research with regards to alliance formation and value creation. I will start with a brief review of the resource-based view's origins and core propositions. Second, I will discuss the challenges of developing a resourced-based perspective of alliances and networks and present some promising attempts to "stretch" the RBV and make it more applicable to the network context. Finally, the RBV´s contributions to alliance formation and value creation in alliances and networks will be assessed.

1.2.1 An introduction to the resource-based view

Origins of the resource-based view date back to as early as the 19th century, when Ricardo explored fertile land as a productive factor (Ricardo, 1817). He told the story of two firms producing wheat on two parcels of land, one of which was fertile (low cost of production), and

one of which was not (high cost of production). Ceteris paribus and under the assumption of one single market price the firm with the less fertile land would have higher costs (e.g. for additional fertilizer) and therefore couldn't earn an economic rent. Since fertile land is assumed to be inelastic in supply, the performance difference would persist. Today, the resource-based view suggests that a firm controls a bundle of resources, many of which are inelastic in supply and therefore potential sources of economic rent (Barney and Arikan, 2001: 128).

In the 1980s, Porter's competitive strategy (1980) was the prevailing theory of competitive advantage. According to Porter, a firm can gain competitive advantage by positioning itself well in a profitable industry (Porter, 1980, 1985). Against this background, Wernerfelt developed a theory of competitive advantage based on superior resources as a complement to Porter's framework. He argued that – instead of specifying product markets, a firm might choose to specify a resource profile and only then decide on the optimal product-market activities (Wernerfelt, 1984: 171). Today, the core notions of the resource-based view have long been recognized as the fundamentals of strategic management. Organizations possess heterogeneous resources and capabilities, which they may lead to competitive advantage to the extent that these resources are superior relative to rivals (Andrews, 1971; Peteraf, 1993: 179). Barney states that firm resources "…include all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness" (1991: 101). Resources thus include physical assets, human capital, as well as organizational capital. For firm resources to be a source of competitive advantage, they have to be valuable, rare, difficult to imitate and difficult to substitute (Barney, 1991: 106ff).

Peteraf (1993) goes further by explaining in greater detail how a firm can generate and sustain such resources. She provides an extensive model of four conditions that must be met to achieve sustained competitive advantage. Heterogeneity is the sine-qua-non, a necessary but not sufficient precondition of sustained competitive advantage. Heterogeneity implies that some resources are superior, or "more valuable" relative to others and may create competitive advantage (Peteraf, 1993: 185). Competitive advantage arises if a firm implements a value creating strategy which is not simultaneously being implemented by competition.

However, competitive advantage can only be sustained if competition is unable to duplicate the benefits of this strategy (Barney, 1991: 102). Peteraf uses the term "ex-post limits to competition" to refer to imperfect imitability, imperfect substitutability and imperfect mobility of

firm resources (Peteraf, 1993: 182-184). Rumelt (1984) introduced the concept of isolating mechanisms to describe firm-level factors that hinder competition from imitating value generating resources and strategies. These include property rights, causal ambiguity, producer learning, and reputation. Special attention has been given to valuable but non-tradeable assets, which have a strong tacit dimension, are socially complex, and are central to the resource-based view. Dierickx and Cool (1989) identified the following factors that impede imitation: time compression diseconomies, asset mass efficiencies, interconnectedness of asset stock, asset erosion, and causal ambiguity. Focus thus shifts to the asset accumulation process as the development of resources is path dependent, i.e. dependent on prior managerial decisions and firm activities (Peteraf, 1993: 183). Such resources are not only difficult to imitate but also bound to the firm and thus imperfectly mobile (i.e. specialized supplier networks; specialized employees).

So far, we have looked at the preconditions for competitive advantage as well as the mechanisms necessary to make it sustainable. However, sustainable competitive advantage will only turn into sustainable rents if the ex-ante costs to acquire the resources are below their value on the product market. The main challenge for management is thus to compete effectively in factor markets by choosing a combination of resources whose value is underestimated. According to Barney (1986), managers must either have good foresight or luck to accomplish this difficult task. Ahuja and Katila (2004) suggest that firms develop strategic resources due to idiosyncratic situations. Specifically their findings show that technology exhaustion and expansion beyond national markets trigger firms to develop unique ways to search for new innovations. But what if a firm does not possess (sufficient) resources on which to build on? One option is obviously to develop weaker resources, but as soon as they are not rare or imitable, this process will not lead to sustained competitive advantage. Instead, Miller (2003) investigated two dozens of these “weak” firms and found out that some could overcome their dilemma by focusing on asymmetries rather than on capabilities. Asymmetries are unique assets of a firm, not necessarily valuable, but hard to imitate by rivals. If firms can find, develop and leverage their particularities in a way that they meet specific market needs, these asymmetries might become strategic resources leading to sustained competitive advantage (Miller, 2003: 961). Competition thus occurs already on factor markets when firms are acquiring and developing resources which later should yield sustainable rents.

1.2.2 The resource-based view in the context of alliance and network research

After having discussed the core elements of the resource-based view, this chapter will shed light on the role of alliances and networks within the resource-based view. First, the challenges of developing a resource-based view of alliances will be discussed. Second, the "relational view" will be introduced as a path-breaking new concept in alliance research[2]. Third, I will make an attempt to conceptualize alliances and networks within the resource-based view.

1.2.2.1 The challenges of developing a resource-based view of alliances

The traditional resource-based view as described above holds that a firm's strategic resources must rest within the firm's boundaries. Barney defines resources as "all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by the firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness" (Barney, 1991: 101). Amit and Schoemaker conceptualize resources as "stocks of available factors that are owned or controlled by the firm" (Amit and Schoemaker, 1993: 35). This general proprietary assumption is also in line with the concepts of resource heterogeneity, imperfect resource mobility and isolating mechanisms. Like Porter's (1980) competitive strategy, which was the prevailing strategy framework when the resource-based view emerged, the latter focuses on the firm as unit of analysis and sees other market players as rivals and assumes away any collaborative type of rent (Barney, 1991; Wernerfelt, 1984). Through the lens of this traditional, internally oriented resource-based approach, alliances are but an instrument to get hold of required resources and should be terminated as soon as learning is completed (Duschek and Sydow, 2002: 427). Strategic resources cannot be acquired through simple market transactions, as due to governance constraints only unspecialized resources can be traded on the open market. On the other hand, building required resources internally is often too costly and too time consuming. Therefore, whenever skills acquisition (learning) is the main goal of the alliances, it can be viewed as an alternative means to get hold of the required resources (Duschek and Sydow, 2002: 427). However, only if partner skills are internalized through acquisition or merger, they can be used freely outside the agreement and applied to new markets and products (Hamel, 1991). Within this traditional RBV, the main goal of an alliance is to internalize non-

[2] Although the relational view largely builds on resource-based logic, it also draws on transaction cost economics and even social network theory. Therefore, it will be discussed in greater detail in chapter 1.4.2.

marketable resources (Duschek, 1998; Rasche, 1994: 233) which results in "competitive collaboration" and "learning races" (Hamel, 1991).

1.2.2.2 A paradigm shift: the relational view of competitive advantage

In stark contrast to the internally focused resource-based view, the "relationally oriented resource-based approach" focuses on the dyad or network as basic unit of analysis (Duschek and Sydow, 2002: 428). In its core, the relational approach holds that strategic resources are embedded in a firm's inter-organizational relationships. Competitive advantage is created in inter-firm relationships and cannot be enhanced independently of a firm's network of relationships (Duschek, 1998: 235; Dyer and Singh, 1998: 660; Gulati, et al., 2000: 203). Dyer and Singh define a relational rent as "a supernormal profit jointly generated in an exchange relationship that cannot be generated by either firm in isolation and can only be created through the joint idiosyncratic contributions of the specific partners" (Dyer and Singh, 1998: 662). Although strongly rooted in the resource-based theory, the relational view also draws on transaction cost economics (e.g. Dyer and Singh, 1998: 662, 669) and social theories of network embeddedness (e.g. 667, 669, 671). Therefore, the relational view will be dealt with separately in chapter 1.4.2, which focuses on the combined implications of resource-based and transaction cost based approaches.

1.2.2.3 The interconnected firm: an extension of the resource-based view

Traditional "theories of the firm", such as the resource-based view, have envisioned firms as independent entities that compete against each other. At the same time, since the early 1980s, we have observed an increasing emphasis on alliance formation and alliance performance in main stream strategic management literature. Scholars have long neglected the logic behind the competitive advantage of firms participating in alliance networks. The relational view (Dyer and Singh, 1998) was a first step towards extending the resource-based view and integrating it with other theories to adapt it to an increasingly alliance-dominated business world. Building on the findings of the relational view, Lavie (2006) extends the resource-based view to incorporate network resources as important driver of competitive advantage.

Some basic assumptions of the resource-based view have to be reconsidered in order to explain how a firm can extract value from resources that it doesn't fully own or control. Resource heterogeneity and imperfect mobility have been identified as preconditions for competitive

advantage (Barney, 1991). Alliances may contribute to resource heterogeneity, which remains a critical precondition even in a networked environment. Alliances facilitate the mobility of resources or at least enable the transfer of benefits associated with such resources, a fact that weakens the imperfect mobility condition (Lavie, 2006). Given that the proprietary assumption of the resource-based view is relaxed, a firm can extract rents from internal resources, shared partner resources and nonshared partner resources (see Figure 2). Total rent earned is comprised of internal rent, appropriated relational rent and inbound spillover rent –minus outbound spillover rent (Lavie, 2006: 644).

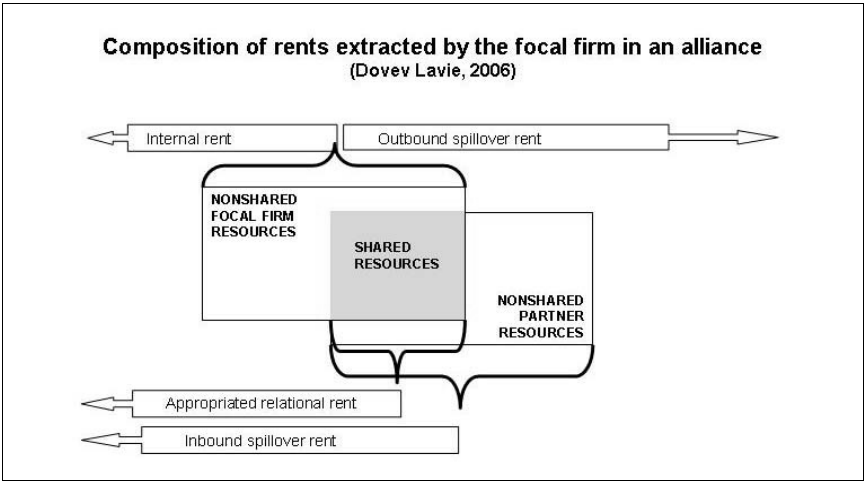

Figure 2: Composition of rents extracted by the focal firm. Source: Lavie (2006)

Obviously, this approach combines perspectives of the traditional resource-based view and the newer, relationship-oriented resource-based view (Duschek and Sydow, 2002; Dyer and Singh, 1998) . Although primarily developed for dyads, Lavie generalizes his model of rent generation to the network context in the Appendix of his paper (Lavie, 2006).

1.2.2.4 An attempt to conceptualize strategic alliances and networks within the resource-based view

So far, the challenges of developing a resource-based view of alliances have been discussed and two extensions of the resource-based view, namely the relational view and the concept of the

interconnected firm, have been presented as promising new approaches to the study of alliances. The relational approach differs from the traditional, internally oriented RBV in two main ways. First, the unit of analysis is the dyad instead of the individual firm. Second, the potential for generating and sustaining rents is embedded in interfirm networks and not in individual firm level resources only (Duschek and Sydow, 2002: 430). The aim of this chapter is to arrive at a resource-based definition of alliances and networks to encompass both the traditional and the relational approach. Also, learnings from the interconnected firm (Lavie, 2006) will be incorporated.

Alliances

Within the traditional resource-based view, alliances are seen as vehicles to gain access to strategically relevant resources and thus alternative means of resource acquisition to acquisition (as compared to in-house development[3] (Das and Teng, 2000: 36; Duschek and Sydow, 2002: 427; Hamel, 1991: 99). Apart from being a strategic tool to obtain resources, an alliance can also be conceptualized as tool to *retain* resources. A firm may have under-utilized resources and - instead of selling them right away – might want to bring them into an alliance where they can be employed profitably for a specified period. Moreover, a firm might wish to combine and develop its resources with a partner in order to prevent their skills and knowledge from decaying (Das and Teng, 2000: 38; Kogut, 1988; Peteraf, 1993). Either way, the realized value of the resources brought into the alliance has to be bigger than their value realized by selling them or using them internally (Das and Teng, 2000: 38). In this context, alliances are but one way of obtaining and deploying a firm's resources.

Within the relational view, however, the alliance becomes a source of competitive advantage itself, because strategic resources are embedded in interfirm linkages (Duschek and Sydow, 2002: 428; Dyer and Singh, 1998: 661). To the extent that inter-firm linkages are valuable, rare and difficult to substitute and imitate, they can be seen as strategic resources. Alliances, and especially networks of alliances, have a difficult-to-imitate history of development. This path-dependency serves as an isolating mechanism which allows for the alliance to be a source of sustained competitive advantage (Dierickx and Cool, 1989; McEvily and Zaheer, 1999). Gulati et al. (2000: 207-209) distinguish between network structure, network membership, and tie

[3] In contrast to hierarchies and hybrid organisational forms, the market is not seen as a means to obtain strategic resources. By definition, marketable resources are not specialized and can thus not be a source of competitive advantage (e.g. Duschek and

modality as strategic resources. In addition to these structural characteristics, alliance formation and management capabilities are regarded as significant resource for a firm (Anand and Khanna, 2000; Dyer and Singh, 1998).

Although traditional resource-based theory and the relational view differ in their views on inter-organizational collaboration, I propose an integrated resource-based perspective on strategic alliances. To sum up, **a strategic alliance can be conceptualized as i) access to shared and nonshared partner resources ii) opportunity to use under-utilized internal resources and iii) a valuable resource and locus of rent generation itself - through the creation of co-specialized assets and idiosyncratic situations.**

In networked industries such as biotechnology, semiconductors and communication technologies, the knowledge base is highly complex, fast changing and widely dispersed in the network (Kogut, 2000: 411; Powell, Koput and Doerr, 2004: 116). Companies need to co-operate to come up with innovative solutions before competition does. Network membership thus is necessary to catch up with new developments and favorable positions within the network ensure that all essential information will be received in time. The link between collaboration and organizational learning and innovation is strongly emphasized in the network literature (see i.e. Powell and Brantley, 1992). "A network serves as a locus of innovation because it provides timely access to knowledge and resources that are otherwise unavailable, while also testing internal expertise and learning capabilities" (Powell, et al., 2004: 119). From this insight it follows that relationships must not be treated independently. Knowledge should be transferred across alliances in order to leverage results and boost one's own strategic position in the industry network (Duysters, De Man and Wildeman, 1999: 186; Powell, et al., 2004: 120). Resources acquired through networks are path-dependent and cannot easily be imitated by competition – a facts which renders them a potential source of competitive advantage (McEvily and Zaheer, 1999: 1138).

To sum up, it can be said that generally alliance-based benefits (as described above) accrue to network members embedded in multiple alliances as well. The opportunity to use under-utilized resources is, however, not emphasized in the network literature. Instead, the notion of knowledge creation, inter-organizational learning and innovation is emphasized in the strategic network literature. Therefore, **a firm's alliance network can be conceptualized as i) access to shared**

Sydow, 2002: 427; Dyer, 1996)

and nonshared partner resources, especially knowledge ii) locus of innovation through the integration of knowledge otherwise dispersed in the network, and iii) an essential tool for an integrated management of internal and external resources.

1.2.3 A resource-based perspective on alliance and network formation

The resource-based view has its own logic of when to ally and when to acquire. As explained in the previous section, (traditional) resource-based theory sees alliances as means to access strategically relevant, otherwise unavailable resources (Das and Teng, 2000: 36). Essentially, there are three distinct means to obtain new strategic resources, which are i) internal development, ii) acquisition iii) and co-operation. Acquisition of resources through market transactions is not seen as an effective alternative, as by definition marketable resources are non-specific. Consequently, firms have to engage in "something other than traditional market transaction" (Badaracco, 1991: 100) if they want to develop their strategic resource base (Duschek and Sydow, 2002: 427).

Alliances

The decision about cooperation versus acquisition is based upon a cautious consideration of costs and benefits. Strictly speaking, from a traditional resource-based point of view, an alliance can only be seen as "a half-way house on the road from market to hierarchy" (Hamel, 1991: 99). Eventually a firm will fully integrate the required resources in order to dispose of them freely and use them in various markets for various products (Duschek and Sydow, 2002: 427; Hamel, 1991: 88). Despite of this general tendency towards integration, there are good reasons to ally. When the total costs of integration are higher than the total costs of co-operative approaches, a firm will choose to ally, even if this choice involves significant transaction specific investments and the threat of opportunism (Barney, 1999: 140).

Both the internal creation of resources and the external acquisition can involve significant costs. Barney (1999: 141-142) states four important reasons why firms might flinch from developing strategic resources inside, namely i) the complexity of the historical context ii) path dependency iii) social complexity and iv) causal ambiguity. Whereas these resource characteristics are necessary to create resources that might form the basis for competitive advantage, they also make it almost impossible for managers to develop such resources in the short to medium term and at acceptable costs. If firms cannot create the required resources on their own, they can still use

hierarchical governance to gain access to those capabilities through acquisitions. Barney (1999: 142-143) continues his argument in favor of alliances by discussing five reasons that may render acquisitions too costly. First, legal constraints like antitrust laws and local ownership restrictions might lead to a very troublesome acquisition process. Second, due to the transfer of ownership the target firm might loose customers and eventually market value. Third, a firm curbs its strategic flexibility and opportunities to a large extent with every acquisition it makes, especially in dynamic environments where the technologies age quickly. Fourth, one always has to buy the whole package, even though the specific capabilities needed might only constitute a small portion of the whole bundle and be amply diffused in multiple firm units. Last, it might be very costly to integrate one organization into the other, a practical reality that often leads to divorce. To sum up, a firm will choose co-operation over acquisition if i) only parts of the partner's resources are needed and ii) technological uncertainty leads to an increased need of flexibility (Das and Teng, 2000: 35). Hoffmann and Schaper-Rinkel (2001: 153) present a useful framework for supporting the decision making process between alliances and acquisition. The choice between the two different modes of governance is essentially a continuum (and trade-off) between control and strategic flexibility. These two basic requirements have to be balanced by top management.

In addition to the above, the nature of resources might also be an aspect to consider. Tangible assets can easily be integrated upon acquisition, whereas intangibles (i.e. human resources) might be more productive in an alliance (Dyer, Kale and Singh, 2004: 112). Hennart and Reddy (1997) investigate the choice of Japanese investors between acquisitions and joint ventures in the US. Their results suggest that equity joint ventures are preferred if only parts of the assets are needed, the Japanese investors have little experience in post-merger activities, and if the investor and the US partner manufacture the same product. Other interesting findings in this field suggest that the relationship between market dynamics and strategic alliance formation is moderated by firm resources. Resource-rich firms tend to use alliances in volatile markets whereas resource-poor firms become relatively more active in alliance formation in stable markets (Park, Chen and Gallagher, 2002). Obviously both strong and weak resource positions accelerate alliance formation in certain contexts. Eisenhardt and Schoonhoven (1996: 138) show that alliances are formed when firms are in weak strategic positions or when firms are in strong social positions and have the necessary contacts to other firm's top management. Both strategic and social factors are essentially firm resources which in sum support the resource-based theory of alliances.

From a relationally oriented resource-based view, resources that create sustained competitive advantage are embedded in inter-firm relationships and cannot be obtained otherwise. Thus the relational view doesn't even ask the question whether to acquire or to ally (Dyer and Singh, 1998).

Networks

In a networked environment, criteria for boundary decisions can be considered rules of network development. The question is not only whether to form an alliance or not, but also and even more importantly with whom to form the alliance. Yet the decision making process is restricted by one's own attractiveness to other firms and the availability of potential partners. Broadly speaking, in a networked context, firms build alliances for resource reasons, but also according to opportunities that arise from existing links (Ahuja, 2000b). A firm's embeddedness in a network of ties (prior and existing alliances) enhances network resources and managerial capabilities, which in turn have a positive impact on alliance formation. More precisely, network resources help to gain access to the best partners due to superior quality of information, time advantage, and referrals by (former) network partners (Gulati, 1999). Other studies focus rather on why a particular partner is chosen. Chung et al. (2000), for instance, explain the probability of allying with a particular partner by criteria such as resource complementarity, status similarity and social capital. Scholars disagree on the question whether resource rich firms or resource poor firms are more likely to enter into alliances. One solution might be to look at moderating factors, such as uncertainty. Park, Chen and Gallagher (2002) found that in volatile markets, resource rich firms obtain external resources through alliances, whereas in stable markets, resource poor firms get their chance.

It becomes clear from this analysis that link formation in a networked context can hardly be explained by the resource-based view alone. Most scholars draw on both the resource-based view and social network theory to study network development. Whereas the traditional boundary decision is based on the choice between co-operation, acquisition and merger (or in-house development), network studies rather focus on criteria influencing a particular partner decision. Centrality, good reputation and alliance experience usually increase partnering opportunities. Resource complementarity is often a criterion, but not necessarily always. As networked industries are usually dynamic and thus relatively instable, resource rich firms can more easily enter into alliances with their preferred partners, or as Eisenhardt and Schoonhoven put it: "Cooperation requires resources to get resources" (Eisenhardt and Schoonhoven, 1996: 147).

1.2.4 A resource-based perspective on value creation in alliances and networks

The aim of achieving sustained competitive advantage and ultimately enhanced performance lies at the very heart of the resource-based alliance literature. Within the traditional resource-based view, alliances are seen as a means to obtain strategically relevant resources that have the potential to enhance competitive advantage. Whereas the previous chapter dealt with the question of how to enhance competitive advantage by making the right boundary decision, this part will rather focus on how to turn the performance enhancing potential of the alliance into tangible benefits for the focal firm. As we have seen in the previous chapters 1.2.2.1 to 1.2.2.4, the traditional resource-based view is limited in explaining rent generation through strategic alliances. Still, this chapter focuses purely on the contributions of the traditional resource-based view to understanding value creation in alliances and networks. The concept of the interconnected firm has already been presented in chapter 1.2.2.3 and the relational view will be discussed in detail in the final discussion in chapter 1.4.2.

Alliances

Alliances are formed to enhance firm performance. Managerial evidence has shown, however, that they do not necessarily achieve this optimistic goal. The rent generating potential thus doesn't lie in the decision to cooperate as such, but much rather in the way the cooperation is managed. Alliance success is strongly influenced by a firm's alliance management capability and absorptive capacity. The success of an alliance ultimately depends on many different factors, which can broadly be classified into i) firm characteristics, ii) relational characteristics and iii) context characteristics (Das and Teng, 2000; Ireland, Hitt and Vaidyanath, 2002; Kim and Park, 2002; Mohr and Spekman, 1994). The resource-based view traditionally focuses on partner characteristics, namely resource complementarities and alignment, technical competence, managerial know-how and alliance management capabilities. Specifically alliance management capability, also referred to as "network capability", has been widely discussed in the resource-based alliance literature. Kale et al. (2002: 749-751) state that alliance experience is a necessary yet not sufficient condition for the establishment of alliance capability. They argue in favor of a dedicated alliance function, especially when a portfolio of alliances has to be managed simultaneously. Investing in such a dedicated alliance function can enhance a firm's alliance capability by i) acting as a central point for knowledge accumulation, ii) keeping stakeholders up-to-date, iii) improving internal coordination and resource support, and iv) evaluating alliance performance (Kale, et al., 2002: 752). Anand and Khanna (2000) further investigate the role of

experience in leveraging alliance performance and find strong effects of learning on value creation in alliances, specifically in explorative settings and joint ventures. Lorenzoni and Lipparini (1999) argue that the ability to interact successfully with other firms, which they coin "relational capability", develops over time and leads to improved performance. Similar outcomes are suggested by Duysters and Heimeriks (2002), who looked at functions, tools, control processes and external parties as critical mechanisms to build alliance performance.

The resource-based perspective thus highlights important aspects of performance enhancement in alliances focusing on the positive effects of resource synergies across partners. This approach is, however, limited in taking relational factors like commitment, trust, opportunism or transaction-specific investments (Dyer, 1996; Skarmeas, Katsikeas and Schlegelmilch, 2002) and contextual factors like the embeddedness of partners (Blankenburg Holm, Erisson and Johanson, 1999), into account. In a networked business environment, the structural and relational embeddedness of the alliance partners affect value creation and destruction in alliances and should thus be part of performance studies. This is why scholars increasingly combine multiple theories to build better models of performance in a networked setting (Mohr and Spekman, 1994; Saxton, 1997).

Networks

By implementing a well-balanced strategy for a firm's entire set of alliances, resource-based effects on performance through alliances can be leveraged. Network participation can enhance firm performance through the supply of valuable resources, above all knowledge. Apart from this obvious benefit, network participation can also enhance the status and reputation of the firm, thus boosting its bargaining power vis-à-vis customers and suppliers. Network embeddedness leads to better network capabilities which in turn enhance the quality of the future network (Gulati, 1999). Absorptive capacity, a firm level characteristic, is as important as a favorable network position when it comes to innovation and performance (Tsai, 2001).

The conclusion of this chapter is obviously that the resource-based view can only partially explain the performance enhancing effects of networks. Extensions of the resource-based view to systematically explain the sources of competitive advantage of the embedded firm offer a sound basis for further research. Internal capabilities and external ties are interlinked and interact to impact performance (Lavie, 2006; Lee, Ch., et al., 2001).

1.3 A critical assessment of SNT's contribution to alliance and network research

The amount of social network research has increased dramatically in the past 20-30 years (Borgatti and Foster, 2003: 992). Originally developed by sociologists and applied mainly to the analysis of interpersonal relationships, it has long found its way to the core of organization studies, management literature and strategy research. This development can be understood as part of a major trend in economics and strategy away from the analysis of individual actors toward a more relational perspective on economic exchange and coordination (Borgatti and Foster, 2003; Macaulay, 1963). Brass et al. (2004) organize network research into three broad categories, that is the interpersonal, the interunit, and the interorganizational levels of analysis. This paper's focus is on the latter, more specifically on the study of interfirm strategic alliances and networks.

To understand how a firm can derive benefits from engaging in strategic alliances and networks, one has to look at several areas of social network research. First, this chapter will discuss origins and basic assumptions of social network theory (SNT). Second, it will talk about antecedents of networks, that is social network theory's perspective on how networks are formed and evolve. Third, consequences of networks will be discussed. Within the latter field of research, emphasis will be put on beneficial outcomes of alliances and networks for the focal firm, such as the improvement of competitive advantage and performance.

1.3.1 An introduction to social network theory

The aim of this chapter is to give an overview of the basic assumptions and concepts in social network research and to contrast them with the traditional economic (neoclassical) perspective on exchange. After a brief definition of terms, the role of social capital and the concept of embeddedness in social network research will be explained.

A network is basically defined as a set of actors ("nodes") connected by a set of ties ("threads"), which can be directed or undirected, dichotomous (i.e. present or absent) or valued (i.e. strength or type of relationship). An actor is called "ego" once the analysis is conducted from its point of view. The collection of an "ego" and its ties ("alters") is usually referred to as ego-network. In ego-network studies, it is possible to draw a random sample of a large population, just as in traditional statistical methods (Borgatti and Foster, 2003: 992; Wasserman and Faust, 1994). Generally speaking, the relations are just as important as the actors they connect. Traditional statistics focus on actors and attributes, network analysis focuses on actors and relations. Given

the fact that network data are fundamentally dyadic, hypotheses are formulated at the dyadic level. Gulati and Gargiulo (1999), for instance, show that the existence of previous ties among two firms increases the probability of a future alliance between the same parties. Naturally, hypotheses can be tested also at the actor or network level.

1.3.1.1 The role of social capital

Although social capital is a widely used concept in the study of alliances and networks, it still seems somewhat vague and uncertainty about its meaning and effects remains (Koka and Prescott, 2002: 815). Broadly speaking, social capital is the total value of an actor's connections. For the purposes of this review a definition similar to Inkpen and Tsang's (2005: 151) will be adopted. I define **social capital as the aggregate of resources embedded within, available through, and derived from the network of interfirm relationships possessed by a firm**. This definition highlights the fact that the value of social capital depends very much on the capacity of the owner to detect and appropriate it.

The concept of social capital of firms is strongly related to the concept of network resources. Both concepts can better be explained by the resource-based view and social network theories *together*. Therefore, the impact of social capital on firm performance will be dealt with separately in chapter 1.4.3, where multi-theory concepts are reviewed.

1.3.1.2 Embeddedness and economic performance

The concept of embeddedness is arguably the core element of social network theory. Its origins lie in an attempt to find the golden mean between over-socialized concepts of sociology and under-socialized (rational) actors in economics (Borgatti and Foster, 2003: 994). In his seminal paper, Granovetter (1985) points out that all economic action is necessarily embedded in a larger social context. More particularly, he turns away form the "atomistic actor" towards the picture of economic exchange being embedded in structures of social relationships. His critique turns not only towards economic theories of exchange (particularly Williamson, 1975), but also towards an over-socialized conception of men as being extremely sensitive to the opinions of others (for an exhaustive critique see Wrong, 1961). Despite of the stark contrast between the over- and undersocialized theories, both share the conception of atomized actors. Granovetter (1985) further argues that social relations are important generators of trust and that trust, in turn, is an important control mechanism in economic life. He insists, though, that social relations might be a

necessary, yet not always sufficient condition for trustworthy behavior to develop (1985: 491). Williamson (1975) holds that opportunism in complex exchange situations can be inhibited through hierarchically integrated firms. Granovetter, on the other hand, believes that order and disorder are more related to the structure of relations than to organizational form. Even across firm boundaries, order and protection against opportunism can be achieved through personal relationships and interfirm networks. Integration, thus, is rather a consequence of a lack of social structure (1985: 502-503).

Drawing on Granovetter´s concept of embeddedness, Uzzi (1996: 676) takes the argument further and focuses on sources and consequences of embeddedness. He points out that Granovetter's (1985) core statement, i.e. that economic action is embedded in social relations, is conceptually vague, as it doesn't explain precisely how the social context affects the economic performance of organizations. Uzzi (1996: 676) refers to embeddedness as the "exchange logic" specific to organization networks, which differs from the exchange logic of markets. "The key implication is that the level of embeddedness in an exchange system produces opportunities and constraints that are particular to network forms of organizations and that result in outcomes not predicted by standard economic explanations" (Granovetter, 1985: 676). Findings from an ethnographic study of New York-based apparel firms suggest that embedded ties facilitate economic exchange via three main mechanisms, such as i) trust, ii) fine-grained information transfer, and iii) joint problem-solving arrangements (Uzzi, 1996: 678, 1997: 42). Trust came out as the primary and most important component of an embedded tie. Trust develops when partners make an extra effort to work things out to the satisfaction of all participants, without using any formal devices to enforce reciprocation. Trust becomes even more important when the partner's action cannot be monitored properly, as is the case very often in complex exchange relationship. Trust typically erodes when it is abused repeatedly (Uzzi, 1997: 43-45). Fine-grained information transfer is another important component of embedded ties and goes far beyond price and quantity information used in market exchanges. Fine-grained information is not only more detailed and tacit than price data, but also has a holistic nature that helps to speed up productive processes in the partnership (Uzzi, 1997: 45). Finally, joint problem-solving arrangements consist of routines of mutual adjustments that flexibly resolve problems "on the fly" (Uzzi, 1997: 47).

But how do these components of embeddedness affect performance outcomes? Uzzi (1997: 62) broadly distinguishes between firm-level effects and network-level effects of embeddedness. Network-level effects encompass economies of time, allocative efficiency, investment, complex

adaption and pareto improvements. Firm-level effects involve a reduction of haggling and monitoring costs, privileged access to resources, better exchange of complex resources, increased speed of information processing and problem recognition, knowledge preferences and better forecasts, learning and performance feedback, and invention of new solutions (see Figure 3). Broadly speaking, embedded ties enable the exchange of complex products and speed up collaboration processes. Thus embedded ties are especially important in industries where competitive advantage stems from going to the market faster than competition, i.e. craft industries and high-tech industries (see also Powell, 1990). Embeddedness furthermore fosters investment activities because it i) increases expectations that nonbinding exchange will be reciprocated, ii) reduces the complexity of risk by matching investors and iii) links actors via multiple relationships where resources can be shifted around and engaged for various relationships. In embedded relationships, buyers will support contractors when it comes to relation-specific investments. The demand for shared equity is not seen as a sign of distrust but rather as a symbol of strong trust and risk sharing (Uzzi, 1997: 52-53). This discussion obviously recalls the notion of credible commitments in transaction cost economics. However, whereas TCE conceptualizes joint equity sharing as protection against opportunism, the embeddedness approach sees it as symbol of trust.

Uzzi also draws attention to the fact that embeddedness might turn into a liability if i) there is an unforeseeable exit of a core network player, ii) institutional forces rationalize markets or iii) overembeddedness characterizes the network (Uzzi, 1997: 57).

Given the above analyzed benefits of embeddedness, it is not surprising that a stream of literature has emerged that contrasts embedded ties with arms-length relationships (DiMaggio and Louch, 1998; Uzzi, 1996; Uzzi and Gillespie, 2002). Other scholars have tried to merge aspects of transaction cost theory and the embeddedness concept. Both theories are relational and deal with economic exchange. Thus from a transaction cost perspective, embedded ties act as informal governance mechanisms to safeguard transactions (for further elaboration please see chapter 1.4.1 in the final discussion). One has to bear in mind, however, that the deeper logic of the two theories is quite reverse: TCE holds that informal safeguards are employed as tools to reduce transaction costs, whereas social network theory puts the social context first in the analysis of causal links (Borgatti and Foster, 2003: 995; Jones, Hesterley and Borgatti, 1997).

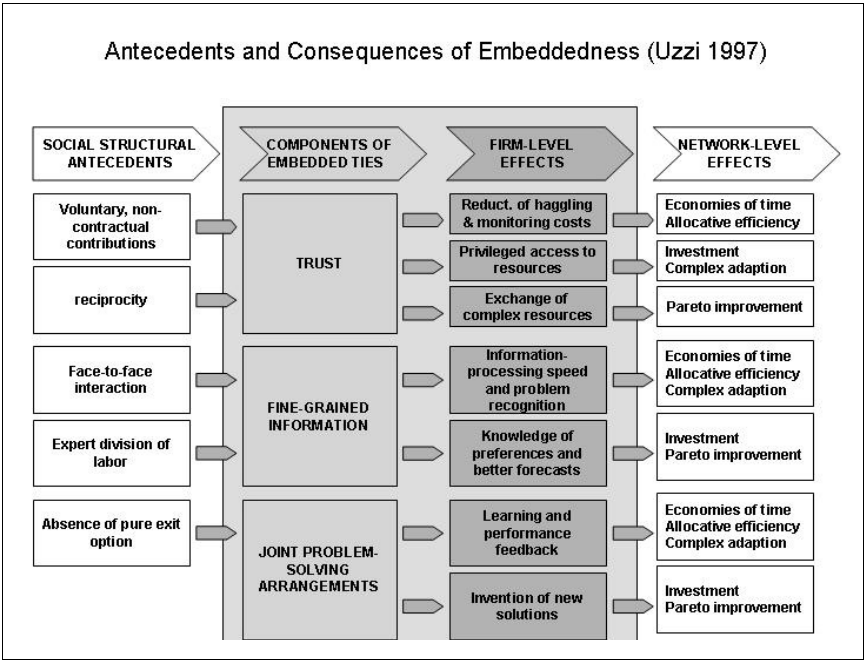

Figure 3: Antecedents, consequences of embeddedness. Source: adapted from Uzzi (1997: 62).

Granovetter (1992) continues the discussion by pointing out two distinct dimensions of the concept of embeddedness, namely relational and structural embeddedness. "Embeddedness refers to the fact that economic action and outcomes, like all social action and outcomes, are affected by actors' dyadic (pair wise) relations *and* by the structure of the overall network of relations" (Granovetter, 1992: 33). Whereas relational embeddedness typically has quite direct effects on the individual actor's behavior, structural embeddedness is more subtle in influencing economic action.

Relational embeddedness perspectives on networks stress tie strength and the role of direct cohesive ties as a vehicle for gaining fine-grained information (Gulati, 1998: 296). Granovetter (1973: 1361) defines the term tie strength as a "combination of the amount of time, the emotional intensity, the intimacy (mutual confiding) and the reciprocal services which characterize the tie". In empirical studies, the construct has been measured by e.g. the frequency of interaction or the level of resource commitment (Rowley, et al., 2000: 371). Scholars focusing on relational

embeddedness usually suggest that strongly tied networks of relationships enhance the development of shared understanding and cohesive behavior, which in turn fosters trust and diminishes uncertainty (Gulati, 1995a; Krackhardt, 1992; Podolny, 1994; Uzzi, 1997).

Structural embeddedness perspectives on networks emphasize the informational value of an actor's structural position in a network. The position an actor occupies is a function of the actor's relational pattern in the network (Gulati, 1998: 296). There is an ongoing debate in the embeddedness literature concerning the performance implications of conflictive structural features of networks. In his analysis of social capital, Coleman (1988) argues that a densely knit network ("closure form") promotes trust and cooperation and is thus beneficial for all members. On the other hand, Burt (1992) emphasizes the efficiency and brokerage advantages of firms embedded in sparsely connected networks. Apart from informational benefits, control benefits may also be obtained through favorable network positions. Burt uses the term "structural hole" for the separation between nonredundant contacts. "A structural hole is a relationship of nonredundancy between two contacts" (Burt, 1992: 18). An actor that bridges such a structural hole can thus take advantage of both informational and control benefits. Burt discusses network benefits by introducing the term "tertius gaudens", where the "tertius" takes advantage of its relations to two separate firms by playing one off against the other and brokering information between the two other players (Burt, 1992: 31). This view is, of course, in stark contrast to Coleman's perspective of closure forms and dense ties.

The fundamental question remains: How should firms be embedded in their industry network and how does network configuration affect economic performance? Rowley, Behrens and Krackhardt (2000: 370) take a contingency approach to analyze the conditions under which sparse (dense) networks and strong (weak) ties positively influence performance. They argue that the essential function of both types of embeddedness is the governance of exchange relationships in the network. Thus, if a company is embedded in, say, a dense network, establishing strong ties might be not necessary and thus constitute a redundant governance structure. Strong ties are less beneficial in dense networks. Furthermore, a firm's environment and strategic goal setting are important conditions to consider. In stable environments, strong ties and dense network structures are more favorable, weak ties are beneficial in more dynamic industries.

1.3.2 Social network theory's perspective on alliance and network formation

Network studies typically focus on either the antecedents (causes) or the consequences (benefits) of inter-firm networks (Borgatti and Foster, 2003: 1000; Brass, et al., 2004: 785). The bulk of network research has dealt with consequences of networks. However, there is a growing body of literature that turns to network antecedents as well (Gulati, 1995b; Gulati and Gargiulo, 1999; Madhavan, Koka and Prescott, 1998). This section will give a brief overview of antecedents of link formation from a social network perspective.

Firms enter into strategic alliances for various reasons, which can roughly be classified into i) reduction of (transaction) costs, ii) strategic positioning and iii) obtaining valuable resources (Gulati, 1998). Social network research per definition doesn't look at individual alliance formation decisions but rather at general rules underlying the evolution of the whole network of alliances. Social network studies on link formation have focused on two main questions, namely i) which firms are more likely to enter into alliances than others, and ii) who tends to partner with whom (Gulati, 1998: 300).

Empirical findings suggest that a firm's proclivity to enter into alliances is influenced not only by their resource attributes or transaction cost considerations, but also by the structure of their existing network of relationships. The bigger the network of prior alliances, the more likely are firms to enter into new alliances (Kogut, Shan and Walker, 1992; Walker, Kogut and Shan, 1997). Centrality in social networks (e.g. social relationships of the top-management) or the existing alliance network also enhances the formation of strategic alliances (Ahuja, 2000b; Eisenhardt and Schoonhoven, 1996; Powell, Koput and Doerr, 1996; Stuart, 1998). One explanation for this phenomenon is that a firm's embeddedness in a network of prior and existing alliances enhances network resources and managerial capabilities, which in turn have a positive impact on alliance formation. More precisely, network resources bring about valuable information on potential partners, time advantages and referrals by (former) network partners (Gulati, 1999). Other studies focus on the question of who enters into an alliance with whom. Chung et al. (2000) explain the probability of allying by resource complementarity, status similarity and similarity in social capital. Gulati and Gargiulo (1999) show that the probability of a new alliance between two specific firms increases with their interdependence, their prior mutual alliances, common third parties, and their joint centrality in the alliance network.

1.3.3 Social network theory's perspective on value creation in alliances and networks

Social network usually focus on explaining performance differences between individual actors due to their network positions (e.g. Burt, 1992). Naturally, consequences are not limited to performance implications (for an excellent typology of research on network consequences see Borgatti and Foster, 2003: 1004). This chapter, however, focuses on beneficial outcomes of networks that might potentially lead to enhanced performance. First, general aspects of value creation in networks will be discussed. Second, two distinct dimensions of network benefits, i.e. information and coordination, will be analyzed.

1.3.3.1 General aspects of value creation in networks

By its very nature, social network research doesn't focus on dyadic relationships, but rather on an actor's entire network of relationships. Consequently, implications for both dyadic alliances *and* alliance networks will be dealt with jointly in this chapter.

Before going into more detail on the subject-matter, it is essential to distinguish the terms "competitive advantage", "rent" and "performance". Within social network research, all of these terms are being used, however to varying extents and in different contexts. There seems to be a common agreement on the strategic importance of networks for the individual firm amongst scholars of the field (Gulati, 1998: 294; Gulati, et al., 2000: 203; Koka and Prescott, 2002: 795), but only few authors actually use the term "competitive advantage" (Galaskiewicz and Zaheer, 1999) or "competitive capabilities" (McEvily and Zaheer, 1999). The term "performance" is used widely, especially in large scale quantitative studies that naturally have to quantify any advantage derived from network participation. The term "rent" captures the notion of certain types of benefits that accrue to network members, including the underlying logic of creating them. This usage of the term "rent" in the social network literature is similar to the usage of "rent" in the resource-based view, where Ricardian rents accrue to the holder of superior resources. Blyer and Coff (2003: 678) use the economic definition by Milgrom and Roberts (1992: 603) to delineate their own usage of the term rent as "return received in excess of the minimum to attract resources". In a similar vein, Kogut (2000: 413) uses the term "rent" to study different types of advantages and their distribution among network members. He claims that the benefits derived from network membership are essentially rents stemming from the coordination in a network. More specifically, he distinguishes two types of network structures producing two distinct kinds of rents, which he coins "Burt rent" and "Coleman rent". Whereas the terms "Ricardian rent" and

"quasi rent" are well-developed and well-defined in the resource-based view and transaction cost economics, respectively, the terms "Burt rent" and "Coleman rent" refer only to different kinds of benefits that accrue to network members, without explaining the underlying mechanism.

A review of recent social network literature on performance implications of networks suggests a classification of benefits from network participation into two broad categories, that is informational benefits and coordination and control benefits (see Figure 4). In the following, these benefits will be discussed in further detail along with the specific network characteristics required to achieve them. As the same network characteristics can be either beneficial or constraining depending on the specific context and the goal setting of the parties involved (Kogut, 2000: 415; Rowley, et al., 2000: 373), the intent here is not to come up with the description of "superior" network characteristics, but rather with a flexible framework that sheds some light on causal links between potentially beneficial outputs and the underlying driving forces.

1.3.3.2 Informational and resource benefits

Informational benefits are by far the most researched in social network theory, as information is the most critical resource transferred between individuals. In the business context, the term "resources" is used more often and includes both tangible and intangible resources. Informational benefits and resource benefits will thus be used interchangeably in this chapter

Koka and Prescott (2002) define an organization's social capital in terms of the informational benefits available due to its strategic alliances and establish construct validity of their proposed three-dimensional conceptualization of a firm's network resources: i) quality of information, ii) quantity of information and iii) diversity of information. Building on this framework, we will discuss various types of resource benefits along the three dimensions.

Quality of information refers to the depth (richness) of information that can be accessed via an external partner. Uzzi (1997: 48) describes "fine-grained information" as one of the three main components of embeddedness, which he defines as the density of embedded, that is strong, ties. In a similar vein, Andersson et al. (2002: 982) conceptualize "business embeddedness" as the extent to which two business partners adapt to one another and specialize their products and processes. Business embeddedness is then related to the quality of resources obtained and eventually performance.

The quantity of resources accessed is a central topic in studies relating a firm's central position to performance (Koka and Prescott, 2002; Powell, et al., 1996; Powell, et al., 1999). Centrality can be conceptualized as degree-centrality, which is captured by the organization's direct links with other players (Hanneman and Riddle, 2005: 61). Firms with a high degree-centrality are often prominent brokers and are said to be more influential than others because of their privileged access to resources. Sometimes, however, it seems more appropriate to take into account not only the direct connections, but also indirect links (partners of partners). The effect of indirect links on firm performance is, however, weaker if the number of direct links is high (Ahuja, 2000a). Alternatively, an actor's distance to all other actors in a network can be measured. This concept is captured by closeness centrality, which is calculated through the sum of geodesic distances for each actor to all the other actors (Hanneman and Riddle, 2005: 65). Yet another – and very common – approach is to use the eigenvector-based measure of centrality, which utilizes also the intensity of the relationships to calculate centrality (Hanneman and Riddle, 2005: 68; Koka and Prescott, 2002: 802). Even if the quantity of resources accessed depends not only on direct links, they certainly have the strongest impact on outcome variables. Therefore, many empirical studies choose to take the number of alliances (degree-centrality) as a measure for the amount of network resources that can be accessed (Powell, et al., 1996; Stuart and Podolny, 1999).

Diversity of information will be discussed as third dimension of informational benefits. The main argument here is that a mere accumulation of ties is not necessarily beneficial per se and can be very costly indeed unless a marginal contact adds novel, non-redundant information to the portfolio (Burt, 1992; Goerzen and Beamish, 2005; Koka and Prescott, 2002; McEvily and Zaheer, 1999). Burt (1992: 13) holds that the value of information springs from knowing about opportunities first. A company has to find out who can provide them with the necessary information and then focus on a few diverse sources of information. "Size is a mixed blessing…What matters is the number of nonredundant contacts. Contacts are redundant to the extent that they lead to the same peopl, and provide the same information benefits" (Burt, 1992: 17). A structural hole is the separation between nonredundant contacts. A network is considered to be efficient if the average number of indirect links per direct link is maximized. Effectiveness, on the other hand, refers to the total number of contacts reached. The aim is to create an ego-network with only a few primary contacts giving access to many secondary contacts (Burt, 1992: 22). Arguable Granovetter (1973; 1983) was the first to discuss the above described argument, however he focused on tie strength and not structure. He developed his original argument by studying the relationships of individuals looking for a job and found that it is actually "weak ties"

(distant acquaintances) that usually bring about the greatest benefits when looking for a job. The logic behind these findings is that our distant acquaintances are usually not connected among each other, that is they help us to obtain novel information. However, "the causal agent in the phenomenon is not the weakness of a tie, but the structural hole it spans" (Burt, 1992: 27).

NETWORK BENEFITS AND THEIR POTENTIAL DRIVERS

BENEFIT	DIMENSIONS	DRIVERS	STUDIES (examples)
Informational benefits	Quality (rich, fine-grained)	•Strong ties	Uzzi (1996), Uzzi (1997), Andersson et al. (2002),
	Quantity (many sources)	•Centrality •Number of ties	•Koka/Prescott (2002), Powell et al. (1996, 1999), Tsai (2001) •Powell et al. (1996), Stuart/Podolny (1999)
	Novelty (diverse sources)	•Sparse network •Weak ties	•Burt (1992), Goerzen/Beamish (2005), Koka/Prescott (2002), McEvily/Zaheer (1999) •Granovetter (1973, 1983)
Co-ordination & Control	„Relational governance"		
	Trust (relational trust)	•Strong Ties	Uzzi (1996, 1997), Rowley et al. (2000)
	Trust (system trust)	•Dense Network	Coleman (1988, 1990), Rowley et al. (2000), Kogut (2000), Echols/Tsai (2005)
	Joint problem solving	•Dense network •Strong ties	Uzzi (1996, 1997)
	„Brokering position"	•Sparse network	•Burt (1992), Kogut (2000)

Figure 4: Network benefits and their potential drivers.

1.3.3.3 Coordination and control benefits

The other broad category of benefits, coordination and control, comprises several aspects that can be grouped into "relational governance" and "brokering position" (see Figure 4). Whereas in the case of "relational governance" rents to coordination accrue to "membership in the group, with the actual allocation to individual members determined by rules of adjudication and relative bargaining power", Burt rents accrue to "the entrepreneurial broker located in a structural hole (Kogut, 2000: 414).

Relational trust is emphasized as main component of Uzzi's (1996; 1997) embeddedness and is driven by strong, highly embedded ties. Formal contracts are often ineffective governance devices when product complexity is high and there is a strong need for continuous adaptation and collaboration. Strong ties promote the development of trust and can thus serve as efficient governance mechanism (Larson, 1992; Powell, 1990).

Although system trust can be employed as alternative governance mechanism to relational trust, it involves different assumptions. Strong ties produce goodwill between partners based on common understanding and a common history. System trust, however, is created in a dense, closed network where firms must trust "the system" and expect that it will punish opportunistic behavior (Coleman, 1988). "While interconnectedness involves norm creation at the network level, relational embeddedness creates trust at the dyadic level" (Rowley, et al., 2000: 372). The higher the density in a network, the closer it gets to Coleman's "closure of networks", a social system that produces obligations and expectations, information channels, and collective sanctions (Coleman, 1988: 105-108).

Joint problem solving is another benefit that comes along with Uzzi's (1997) embedded ties-argument. Mutual adjustments and flexible problem solving with a heuristic approach save time and costs and give the partners a competitive edge over non-embedded players.

Very different benefits are involved with occupying a "brokering position", that is bridging a structural hole (Burt, 1992). In addition to the above discussed informational benefits, structural holes also offer control benefits giving certain players an advantage in negotiating their relationships. Brokers increase the efficiency of the overall network and receive a rent for this service in return (Kogut, 2000: 414). The "tertius" might, for instance, play the bids of competing players against each other and achieve a higher price (Burt, 1992: 31).

1.4 A review of multi-theory concepts in alliance and network research

After having analyzed the contributions of three individual theories to alliance and network research, we will now turn to a review of combined approaches. The bulk of empirical work draws on at least two theories at a time when studying networks. Likewise, some of the most widely used theoretical concepts in alliance and network research combine two of the three discussed theories. The "network organization" has been a favorite study object in organizational studies and social network research alike since the early 1980s. The "relational view" has gained popularity since Dyer and Singh's (1998) seminal article. Furthermore, "network resources" have been studied by main authors in the field since the mid 1990s (Ahuja, 2000a; Gulati, 1998). Following McCloskey's (1985) argument that good science is good communication, this discussion focuses on the ongoing dialog between different theoretical perspectives on networks.

A review of both theoretical and empirical work to date suggests the use of multiple theories to study alliances and networks.

1.4.1 The network organization: Integrating TCE and SNT

During the 1980s and 1990s, terms like "network organization" (Miles and Snow, 1986, 1992), "network forms of organization" (Powell, 1987, 1990), "quasi-firm" (Eccles, 1981) and simply "network" (Thorelli, 1986) found their way into organization theory and strategic management literature. These terms altogether refer to "organizational forms characterized by repetitive exchanges among semi-autonomous organizations that rely on trust and embedded social relationships to protect transactions and reduce their costs" (Borgatti and Foster, 2003: 995). This stream of literature is partly rooted in transaction cost economics, organizational economics, and contract law as it discusses networks as hybrid forms of organization between market and hierarchy, while at the same time pointing out the limits of Williamson's (1975) polarized discussion of markets and hierarchies (Jarillo, 1988: 32; Thorelli, 1986: 44).

One of the most important debates was about whether network organizations represented an intermediate form between markets and hierarchies or much rather a distinct organizational form characterized by its own rules of exchange (Borgatti and Foster, 2003: 995). Whereas scholars with an organizational economics perspective (Thorelli, 1986: 37; Williamson, 1991b: 281) tend to locate networks on the continuum between markets and hierarchies, authors taking a more sociological perspective argue more in favor of networks as distinct organizational form (Marsden, 1981: 1210; Powell, 1990: 299-300; Uzzi, 1996: 676). There is, however, a strong tendency towards the latter perspective and also Williamson recognizes that hybrid forms of organization possess their own "disciplined rationale" (Williamson, 1991b: 294).

Jarillo explicitly takes a strategic management perspective by defining "strategic networks as long-term, purposeful arrangements among distinct but related for-profit organizations that allow those firms in them to gain or sustain competitive advantage vis-à-vis their competitors outside the network (Jarillo, 1988: 32). Although his analysis framework is based on insights from transaction cost theory, he goes one step further than scholars from similar backgrounds by stressing the active role of managers and specifically the hub-firm in creating and managing these networks with an end to giving the firm a competitive edge.

Social network theory enhances transaction cost based explanations of value creation in at least three ways. First, the cost of gathering information and searching for potential business partners can be reduced. Second, governance costs, i.e. the cost of managing and enforcing contracts, will decrease as formal governance mechanisms are complemented by and partly exchanged for informal mechanisms like trust and reputation. Third, dense networks and common third parties will enhance partner commitment and reduce uncertainty, which will foster investment in relation-specific assets and finally increase relational value (Skarmeas, Katsikeas, & Schlegelmilch, 2002).

1.4.2 The relational view: Integrating RBV and SNT

In contrast to the transaction cost perspective, which focuses on cost minimization, the resource-based view emphasizes value maximization (Das and Teng, 2000: 36). The current increase in alliances cannot fully be explained by transaction cost logic, as in many cases uncertainty and asset specificity would clearly point to acquisition as the only strategic option. Obviously, management has to account for factors other than transactions costs when making a boundary decision (Williamson, 1985: 69, 1991a: 293). If benefits derived from strategic opportunities and complementary resources outweigh already high governance costs, the alliance will still be preferred to hierarchy (Zajac and Olsen, 1993: 138).

In their seminal 1998 article, Dyer and Singh position their "relational view" as complementary and in some way even contradictory concept to the industry structure approach (Porter, 1980) and the internally oriented resource-based view (Barney, 1991; Wernerfelt, 1984). Dyer and Singh start their argument by pointing out that, in order to generate above normal rents, inter-organizational relationships have to be idiosyncratic and thus rare and difficult to imitate. First, even in the alliance context, the ownership of unique (Ricardian) resources is the pre-condition for rent generation. Second, if these resources are skillfully specialized to firm-specific needs and combined with other (Ricardian) resources, the firm can earn firm-specific rents. These rents tend to be more sustainable than pure Ricardian rents, as they involve not only resource selection but also capability building by the firm, which is difficult to imitate. "Resources are imperfectly mobile when they are somewhat specialized to firm-specific needs" (Peteraf, 1993: 183). Third, transaction-specific resources and rents derive from co-specialization of the partner's assets (Madhok and Tallman, 1998, Peteraf, 1993). Indeed, resources are less mobile if sunk costs are involved or if they are co-specialized to another resource without which they would be less

productive. Peteraf (1993) states, however, that a rent generated through co-specialization of resources alone and defined as the excess of an asset's value over its value in its next best use, is not a sufficient condition for competitive advantage. The resources as such must be superior as well, that is Ricardian or monopoly rents must exist as well (Peteraf, 1993: 184). Relational rents (or collaboration-specific rents, as Madhok and Tallman, 1998, refer to them) accrue to an alliance if both firm-specific assets and transaction-specific assets are combined to create value above the sum of the rents accomplishable by the partners without the alliance (Madhok and Tallman, 1998). Value creation in alliances can thus best be explained by combining transaction cost economics and the resource-based view. Therefore I define relational rent as "… supernormal profit jointly generated in an exchange relationship that cannot be generated by either firm in isolation and can only be created through the joint idiosyncratic contributions of the specific alliance partners" (Dyer and Singh, 1998).

Dyer and Singh (1998) identify four major determinants of relational rent creation: i) relation-specific assets, ii) knowledge-sharing routines, iii) complementary resources and capabilities and iv) effective governance. These mechanisms support the realization of the potential value and cover aspects from both transaction cost theory and the resource-based view (Madhok, 2002). First, they argue that value can only be created in the value chain if firms are willing to make transaction-specific investments (Rajan and Zingales, 2000; Williamson, 1985). Second, knowledge-sharing routines are essential for effective inter-partner learning and largely depend on partner-specific absorptive capacity and alignment of incentives (Dyer and Singh, 1998: 666). Next, complementary resource endowments of partners create a bundle or resources which are valuable, rare, and difficult to imitate and can thus be a source of relational rent. The ability of a firm to find the right partner depends largely on its alliance experience, its internal search capabilities, and its access to novel information determined by its network position (Dyer and Singh, 1998: 667). At this point Dyer and Singh even integrate some main ideas of social network theory into their framework, as they shift focus to the impact of a firm's relational and structural embeddedness on firm level outcomes (Burt, 1992; Granovetter, 1985; Gulati, 1995a; Mitchell and Singh, 1996). Finally, the role of effective governance in interfirm value creation is discussed. Transaction cost theory holds that informal governance mechanisms are less costly than formal ones. The argument in favor of network embeddedness goes even further in explaining how these informal mechanisms like trust and reputation develop and how they can be sustained. Effective governance increases relational rents by lowering transaction costs and/or by fostering learning and skills sharing. Dyer and Singh also suggest "isolating mechanisms" to

preserve relational rents: inter-organizational asset interconnectedness, partner scarcity, resource indivisibility, and a difficult-to-imitate institutional environment. Finding the right partners is a particularly difficult task as they should control complementary strategic resources and already have some relational capability. Network experience and network context may readily influence a firm's partner selection capability. Likewise, the institutional environment can either increase or lower the transaction costs associated with a specific inter-organizational relationship (Dyer and Singh, 1998: 673).

1.4.3 Network resources: Integrating RBV and SNT

Strategy scholars – and social network researchers in particular – have employed the term "social capital" to refer to a firm's external relationships (originally it was used to refer to an individual's network of social relationships). In a similar vein, the term "network resources" has been employed to refer to the benefits derived of a firm's alliance network. The aim of this section is to describe and define these terms, first social capital and then network resources, as the latter builds on the first.

Although social capital is a widely used concept in the study of alliances and networks, it still seems somewhat vague and there remains uncertainty about its meaning and effects (Koka and Prescott, 2002: 815). In a general sense, social capital is the total value of an actor's connections. The term "capital" refers to the fact that social capital is a "long-lived asset into which other resources can be invested, with the expectation of a future (albeit uncertain) flow of benefits (Adler and Kwon, 2002: 21). Social capital has become a collective term used by scholars from very different backgrounds. Its meaning includes notions of informal organization, trust, social exchange, social resources, embeddedness, relational contracts, social networks, and interfirm networks (Adler and Kwon, 2002: 18).

Bourdieu (1986: 248) defined social capital as "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition". Social capital can be seen as private good owned by individuals to advance their careers and personal bargaining power (i.e. Belliveau, O'Reilly and Wade, 1996; Burt, 1997) or as public good, an attribute to an organizational unit serving not only those who create it but unit members in general (Bourdieu, 1986; Coleman, 1988; Kostova and Roth, 2003). Another important distinction is that between external and internal ties. Whereas some scholars have focused more on social capital as a resource deriving form a unit's external

links to external actors, others have highlighted the value of a unit's internal structure, that is the linkages among individuals within an organization (for an overview of both types of studies see Adler and Kwon, 2002: 20). Adler and Kwon summarize their discussion with the following definition: "Social capital is the goodwill available to individuals or groups. Its source lies in the structure and content of the actor's social relations. Its effects flow from the information, influence, and solidarity it makes available to the actor" (Adler and Kwon, 2002: 23).

Social capital - within the context of interfirm networks - can be conceptualized as a valuable organizational resource originating form the firm's location in market relations, hierarchical relations, and social relations (Adler and Kwon, 2002: 19). Any collaboration in business life frequently involves a mix of all three types of relations. Inkpen and Tsang (2005: 151) eventually define social capital as "the aggregate of resources embedded within, available through, and derived from the network of relationships possessed by an individual or organization". As this definition obviously comprises both individual and organizational forms of social capital, it is important to mention at this point that these two levels of social capital are often interrelated (e.g. social contacts of a CEO might help to set up a joint venture).

For the purposes of this review a definition similar to Inkpen and Tsang's (2005: 151) will be adopted. **I define social capital as the aggregate of resources embedded within, available through, and derived from the network of interfirm relationships possessed by a firm**. This definition highlights the fact that the value of social capital depends very much on the capacity of the owner to detect and appropriate it.

In order to better understand the sources, elements, and consequences of social capital scholars have discussed several related yet distinct dimensions of social capital. A broadly accepted approach is the classification into a structural, a relational, and a cognitive dimension of social capital (Inkpen and Tsang, 2005: 151-152; Nahapiet and Goshal, 1998: 243-244). The structural dimension refers to the overall pattern of relationships, that is who is linked to whom directly or indirectly (Burt, 1992; Wasserman and Faust, 1994). In contrast, the relational dimension refers to the quality of ties, i.e. the type of relationship and the level of trust, norms and sanctions, obligations and expectation (Coleman, 1990; Granovetter, 1985). These distinct dimensions are conceptually linked to Granovetter's (1992) discussion of structural versus relational embeddedness (Nahapiet and Goshal, 1998: 244). The cognitive dimension refers to those resources that provide a common understanding and shared believes, e.g. shared goals and a shared culture (Inkpen and Tsang, 2005: 152; Nahapiet and Goshal, 1998: 244). Social capital

can also be conceptualized as construct that yields three distinct informational benefits. Koka and Prescott (2002: 795) argue that these informational benefits can be broken down to information volume, information diversity and information richness. Whereas the first two dimensions refer to rather structural network characteristics, the latter describes the relational quality of the relationships. Finally it is important to mention that social capital can also have a "dark side", as existing ties might lock-in the actor and impede flexibility and adaption to changing market needs (Borgatti and Foster, 2003: 994). Benefits to social capital are decreasing and might be negative at some point, as costs and conflicts among network members increase (Goerzen and Beamish, 2005; Powell, et al., 1999)

Gulati (1999: 398) introduces the "notion of firm network resources" and convincingly shows that resources obtained from interfirm networks influence the process of entering into new alliances. Network resources inhere in interfirm networks and are thus distinct from resources that reside within a firm's boundaries. The amount of such resources can influence a firm's opportunities and strategic behavior. Gulati (1999: 400) conceptualizes the informational benefits derived from network membership as network resources. Furthermore, he holds that the concept of "…network resources firms can receive from their participation in interfirm networks is akin to the social capital of individuals" (Coleman, 1988; Gulati, 1999: 400; Walker, et al., 1997). Ahuja highlights the fact that "the specific effects of different elements of network structure on organizational performance remain unclear" (Ahuja, 2000a: 425). He operationalizes the firm's ego network in structural terms: direct ties, indirect ties, and structural holes. Koka and Prescott (2002) do not explicitly mention the term "network resources". However, they define social capital similarly to how Gulati (1999) defines "network resources", that is "in terms of the informational benefits available to a firm due to its strategic alliances" (Koka and Prescott, 2002: 795). The type of informational benefits obtained by the focal firm depends on both structural and relational characteristics of the alliance network.

1.5 Discussion and Synthesis

The aim of this final discussion is to point out the specific contributions of the reviewed theories. Which theory should be employed for what kind of research problem? Where do they complement each other and where do they offer contradictory recommendations for the management of alliances?

First, I will summarize the theories' contributions to the topic of alliance formation. Next, I will explore which theory explains what when it comes to value creation and competitive advantage through alliances and networks.

1.5.1 Alliance formation and network development

Make-or-buy-or-ally decisions call for a careful analysis of discrete organizational alternatives. Essentially, costs and benefits have to be balanced and any decision will be a compromise between conflictive internal and external forces. Although it seems impossible to explicitly state the amount of transaction costs involved with a specific mode of governance, these costs certainly constitute an essential part of total costs and therefore have to be considered in the decision making process. A strategic alliance usually involves considerable resource commitments and the management of the daily business takes a lot of time. Control mechanisms have to be set in place to avoid opportunistic behavior and adaptive processes between partners take a lot of time and effort. Transaction cost theory offers straight-forward recommendations concerning boundary decisions, but it largely neglects the effects of resources in collaborative efforts. What if the focal firm is only interested in parts of the potential partner's resource stocks? What if the potential target's employees are the required resource but would leave the company if it changed owner? Other questions involve legal regulations, the general impact of a change in ownership on the value of the firm, and possible knowledge leakage in case of an alliance. Together, transaction cost economics and the resource-based view offer a sound framework for this kind of strategic decision making.

Social network theory, on the other hand, focuses on different aspects of alliance formation. It differs from the above discussed theories in two main ways. First, it doesn't *compare* discrete organizational alternatives. It looks at whether a link is established between company A and B or A and C, but it doesn't ask whether A should establish an alliance in the first place. Social network theory rather seeks to predict a company's propensity to link with a particular type of firm. Put differently, it doesn't look at WHY companies form alliances but rather at WHO allies with WHOM. Second, social network theory holds that the structure of past and existing relationships influences further alliance formation and network development in general. It thus shifts focus from the individual firm's decision to the dynamic evolution of the network as a whole (according to some higher-level rules). Ahuja (2000b) quite accurately coins these external

drivers of alliance formation “opportunities” in contrast to a firm’s “inducements” (i.e. lack of resources) as emphasized by the resource-based view.

From the above analysis it is obvious that social network theory is the better option for network level research, if the aim of the empirical study is to understand the “rules of the game” within a (sub-) industry or cluster. One could even try do model future network evolvement or suggest several possible scenarios. From a firm-level (that is managerial) perspective, the choice of theoretical framework depends on the particular problem. If, for instance, the potential candidate is known and the question is whether to ally or acquire, transaction cost economics and resource-based considerations will be most relevant. On the other hand, if the aim is to outline the firm’s medium to long-term alliance strategy, the industry network has to be taken into consideration. Social network theory specifically helps to find the right partner within a larger network, because it draws attention to non-conventional partner selection criteria: Which partner will enhance my own reputation vis-à-vis my stakeholders? Which partner might be an essential source of information on other potential partners? Does the new partner fit my existing alliance portfolio? Finally, the benefits of re-allying with prior partners (e.g. trust, shared goals, common routines, etc…) should be considered as well.

1.5.2 Value creation through resource benefits

The resource-based view holds that alliances offer access to valuable resources otherwise not (or only at higher cost) available. Furthermore, the strategic alliance becomes a valuable resource itself when complementary partner resources are co-specialized and the “right” governance mechanisms are put in place (Dyer and Singh, 1998). By relaxing the fundamental assumptions of the resource-based view, that is heterogeneity and imperfect mobility (see also 1.2.2.3), rent generation from internal resources as well as shared and nonshared partner resources can be explained (Lavie, 2006).

Alliances and networks offer favorable conditions for obtaining resources that have the potential to be sources of competitive advantage. Peteraf’s (1993) “cornerstones of competitive advantage” lend themselves for analyzing the contribution of networks to the creation of competitive advantage. Resources derived from networks are likely to be heterogeneous as diverse and novel

information can be sourced via a firm's external links.[4] Network resources are also unlikely to be imitated by competitors as they involve interconnectedness of asset stocks, causal ambiguity, social complexity and time compression diseconomies (Dierickx and Cool, 1989; Peteraf, 1993). Path-dependency in a firm's alliance network hinders both imitation by third parties and mobility of resources outside of the relationship. Moreover, ex-ante costs to obtain resources in the factor market can be controlled by a careful and foresighted alliance policy.

Obviously, the resource-based view lends itself well for testing performance implications of alliances and networks, for questions of partner fit and for studying the ability of firms to actually appropriate the value jointly generated. The argument goes that resource-rich firms have more bargaining power and can thus better control rent distribution. Whereas the resource-based view has convincingly shown that, generally speaking, networks offer advantages for the individual firm, it is limited in explaining how exactly networks should be designed to actually deliver the expected outcome.

Social network theory allows for a much more detailed analysis of the drivers of beneficial network outcomes. Management has to make decisions as to the scope, the intensity and the number of alliances. As discussed in chapter 1.3.3 under the heading "Informational benefits", the actual value of a firm's network strategy is contingent upon the firm's specific goals. More precisely, the nature of resources required should influence the design of both the individual alliances and the overall structure of the portfolio. Social network theory thus should be employed in process-oriented research and in studies emphasizing the contingent value of network relationships.

1.5.3 Value creation through coordination and control benefits

Through the lens of transaction cost theory, an alliance (i.e. hybrid mode of governance) is only beneficial if it fits the characteristics of the underlying transaction. Once established, the alliance will create value if the negative consequences of opportunism (moral hazards and hold-up risk) can be mitigated through efficient control mechanisms and if partners make relation-specific investments. "Informal" self-enforcing governance mechanisms (i.e. trust and reputation) are considered to be "cheaper" than formal self-enforcing mechanisms (i.e. hostages) and obviously

[4] *How* exactly novel and diverse information can be obtained via alliances, however, cannot be explained by the resource-based view. Social network theory offers explanations based on discrete network structures (i.e. structural holes).

contracts. Scholars disagree about the question whether formal and informal mechanisms are substitutes or complements, although more recent studies' findings tend to confirm the latter assumption (Poppo and Zenger, 2002; Zaheer and Venkatraman, 1995).

Although both scholars with economic and sociological backgrounds acknowledge the important role of trust in economic exchange, and particularly in strategic alliances, attention has to be paid to the fact that the deeper logic of these two theories is quite reverse. In transaction cost theory, trust is seen as the output of a calculative process and constitutes but one out of many possible control mechanisms (Adler, 2001; Dyer and Singh, 1998). Informal safeguards are implemented because they help to reduce transaction costs. In social network theory, however, social context is put first in the analysis of causal links. Repeated interaction and good experience with the partner create trust and embedded relationships, which again foster rich information exchange and even more trust. Eventually, trust plays an important role as governance mechanism and moreover enhances value creation through better exchange of know-how. The economic perspective, in contrast, conceptualizes trust mainly as instrument to lower transaction costs.

These fundamental differences can best be explained by using examples. Credible commitments, for instance, are considered an efficient means of governance from a transaction cost perspective. Especially in situations where partners don't know each other or risk is very high (und trust is therefore very low), shared equity holdings and joint investments can reduce uncertainty and enhance relation-specific investment. In embedded ties, however, shared equity is not seen as a sign of distrust but much rather as an important sign of trust between the parties involved. Another contradiction between implications from transaction cost theory and social network theory lies in the role of vertical integration for impeding opportunism. Whereas transaction cost theory holds that complex transactions with high asset specificity and high uncertainty can be governed most efficiently by hierarchies, social network theory emphasizes the quality and the structure of (social) relationships as important aspect of governance. Whether these relationships are established within or across firms is of minor importance (Granovetter, 1985; Williamson, 1975). Consequently, transaction cost theory and social network theory may not only be seen as complements in explaining value creation in network. They also contradict each other in their fundamental logic of explaining the development of social context.

Notwithstanding high levels of asset specificity and uncertainty in today's business world, many co-operative relationships are actually very successful. A major part of the value created in such

alliances is certainly due to the existence of efficient social (formal and informal) networks in our society.

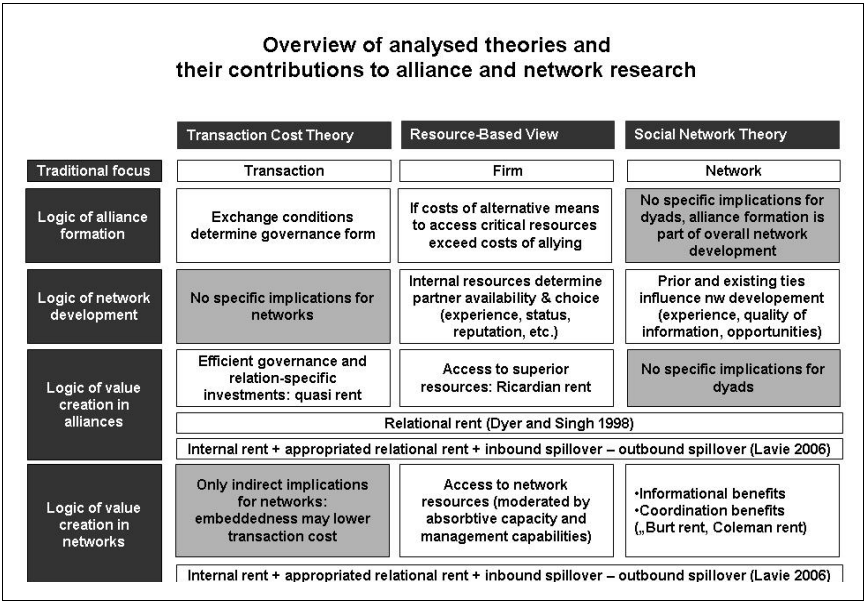

Figure 5: Aalliance and network research: Overview of theoretical contributions.

1.5.4 Conclusion

Figure 5 provides an overview of the individual theories' contributions to the study of inter-organizational relationships. Grey boxes indicate areas of minor contribution. Whereas the resource-based view has been extended to cover all areas of interest in inter-organizational research, transaction cost economics and network theories seem to be more focused. More specifically, transaction cost economics doesn't deal explicitly with multiple alliances and alliance networks, whereas social network theories start off from the network level without considering dyadic alliances on a one-by-one basis. These "shortcomings" could, however, be seen as opportunity for combining different approaches depending on the particular study object. In fact, scholars form both economics and sociology share a long history of interdisciplinary discussion referring to each other (see i.e. Granovetter, 1985; Jones, et al., 1997; Powell, 1990; Williamson, 1991c). In a similar vein, the resource-based view draws on the specific insights from both transaction cost economics and social network theory. Although the resource-based

view is capable of contributing to all areas of inter-organizational research, it doesn't have much explanatory power without teaming up with social network theory and transaction cost economics. Extensions of the resource-based view like the relational view (Dyer and Singh, 1998) and an analysis of the multiple rents that accrue to the interconnected firm (Lavie, 2006) have prepared the ground for further applications of traditional theories for the study of alliances and networks.

This analysis suggests a careful alignment of distinct theories with specific research questions. Whereas the classical make-or-buy decision should be informed by transaction-cost and resource-based theories, social network theory gives insights into partner selection and the configuration of the overall alliance portfolio. In a similar vein, the resource-based view convincingly shows the positive effects of network membership, but it fails to give recommendations as to how alliances and networks should be designed to actually deliver the expected results. Social network theory accomplishes that task and thus complements both transaction cost economics and the resource-based view. However, this analysis has also pointed out conflictive implications of the different theories.

2 Theoretical underpinnings of organizational configurations

At the heart of any research in organizational configurations lies the assumption that we can increase our understanding of organizational behavior and performance differences across firms by identifying distinct, internally homogeneous groups of firms. “Organizational configurations can be defined as commonly occurring clusters of attributes of organizational strategies, structures and processes” (Ketchen, D. J., Thomas and Snow, 1993: 1278). The configurational approach has proved to be especially useful in strategic management to capture the various dimensions of competitive strategy, and indeed several strategic typologies (e.g. Miles and Snow, 1978; Porter, 1980; Zammuto, 1988) have been developed. Configurational studies can be broadly classified into two types: strategic groups and strategic types. Strategic groups are industry-specific and inductively derived using empirical-statistical procedures. On the other hand, strategic typologies are generated deductively and based on theory – and can thus more easily be generalized across industries (Ketchen, D. J., et al., 1993: 1279). Especially followers of the inductive approach have focused on testing for performance differences across strategic groups, however with largely equivocal results (Cool and Schendel, 1987, 1988; Ketchen, D. J., et al., 1993). In the case of strategic typologies, performance differences across groups are usually not claimed, although they typically include at least one “looser” strategy, e.g. Porter’s “stuck-in-the-middle” and Miles and Snow’s “Reactor” (Miles and Snow, 1978; Porter, 1980). In the following, both approaches to the study of intra-industry structure will be discussed.

2.1 Intra-industry structure and strategic groups: the inductive approach

In this chapter, we will discuss roots and main implications of strategic group research as well as its major findings on the relationship between strategic group membership and firm profitability.

The roots of strategic group research

The term „strategic groups“ goes back to Michael Hunt (Hunt, 1972), who used it in his dissertation on the home appliance industry to describe clusters of firms characterized by distinct barriers to entry (McGee and Thomas, 1986: 142). Hunt observed that firms in the home appliance industry differed from each other along three dimensions, namely vertical integration, degree of product diversification and differences in product differentiation, which he called sources of asymmetry (Hunt, 1972: 57). Based on these factors, he found four internally

homogenous strategic groups. At the same time, Newman and Porter studied intra-industry structure in their dissertations on the producer-goods and consumer-goods industries, respectively (Newman, 1973; Porter, 1973). The concept of strategic groups has its roots in the industrial organization (IO) theory, which holds that industry structure determines firm conduct, which consequently determines industry performance (Bain, 1956; Mason, 1939). Entry barriers, the number of firms in an industry and the distribution of firm size where seen as major characteristics of industry structure – and thus as major determinants of industry (and consequently also firm) performance (Bain, 1956: 1280; Ketchen, D. J., et al., 1993). Whereas early contributions (Hunt, 1972; Newman, 1973; Porter, 1973) demonstrated that there is heterogeneity in firm conduct within industries, it was only in the late 1970s that scholars developed a set of theoretical arguments on the causes and implications of strategic groups (Caves and Porter, 1977). Scholars had observed different levels of performance within the same industry and wondered why "high-performers" were not copied by "low-performers". It was argued that so-called "mobility barriers" impeded firms from freely changing their strategies. Followers of the IO approach described mobility barriers as structural forces that where by and large independent of the firm's actions. In contrast to strategic management research - particularly the resource-based view, which later focused on the link between firm-specific characteristics and firm performance - scholars within the IO approach regarded industry-induced entry barriers as the reason for systematic performance differences across groups of firms within the same industry (Caves, 1984: 129; Caves and Porter, 1977: 251; Cool and Schendel, 1987: 1103).

From strategic group performance to firm performance: achievements and criticism

Building on these early findings, Porter (1979) later redirected focus from industry and strategic group performance to individual firm performance. He took the analysis one step further by suggesting that mobility barriers determined only the *potential* for profitability. Firm-specific factors like different risk-profiles, scale differences and different management skills would enhance profitability predictions over those based on strategic group specific factors alone (Cool and Schendel, 1988: 208; Porter, 1979). Regardless of those conceptual findings, empirical research maintained its focus on testing the direct linkage between strategic group membership and firm profitability. While some early contributions focused on one singe variable like firm size (Caves and Pugel, 1980; Porter, 1973), subsequent research used multiple variables (e.g. manufacturing, marketing and financial characteristics) and increasingly sophisticated statistical

procedures – such as cluster analysis, factor analysis and regression analysis (McGee and Thomas, 1986: 149) - to categorize firms into distinct strategic groups (Hatten and Schendel, 1977; Hatten, Schendel and Cooper, 1978).

The achievements of these fundamental contributions to strategic group research can be summarized as follows: First, they presented strategic groups as possible explanation for intra-industry performance variation. Second, key strategic variables and statistical procedures to identify strategic groups were developed (Ketchen, D. J., et al., 1993: 1281). Being rooted in the industrial organization (IO) paradigm, links between strategic groups and different performance levels were mostly regarded as determined by industry structure, not organizational attributes. In empirical studies, typically industries were mapped first, and performance differences between strategic groups were examined a posteriori – without any hypotheses on the number and type of strategic groups or their respective performance levels (Ketchen, D. J., et al., 1993: 1281). Given this approach, it doesn't seem surprising that empirical studies on the strategic group – performance relationship offered only mixed results. Whereas several studies found strong statistical support for the existence of such a relationship (Robinson and Pearce, 1988; Tremblay, 1995), others found only a small or insignificant relationship (Cool and Schendel, 1987; Dowling and Ruefli, 1991).

These unsatisfying results have fostered criticism towards the concept of strategic groups in general. Some authors particularly criticize the focus on statistical methods and the a posteriori nature of empirical studies on strategic groups as dominant weakness of the inductive approach and call for a theory-based approach to organizational configurations research (Ketchen, D. J., et al., 1993; McGee and Thomas, 1986; Thomas, H. and Venkatraman, 1988).

Contemporary research on strategic groups

Notwithstanding the obvious shortcomings of the inductive approach, the concept of strategic groups is still present in more recent empirical studies. Some scholars focus on establishing a sound theoretical basis for the concept of strategic groups; others combine strategic groups with other factors to explain performance variations across firms. Fiegenbaum and Thomas (1995) find evidence that strategic groups act as reference points for group members and their strategies, which allows for predictions of future strategic moves as well as future developments of industry structure. Tang and Thomas (1992) aim at developing the theoretical foundations of the concept of strategic groups by linking it to theories of spatial competition and cognitive taxonomy.

Peteraf and Shanley (1997) take a different approach and argue that managers typically cognitively identify strategic groups in their industry. They develop the concept of "strategic group identity" (Peteraf and Shanley, 1997: 166) and show how strong group identity may have positive performance effects for members of the group. Boyd (2004) successfully combines the concept of strategic groups with the concept of strategic blocks and shows that more accurate predictions of performance differences can be derived through an integrated approach. Strategic blocks are strategic networks of companies closely tied to each other by multiple strategic alliances. In today's networked business world, strategic block membership might be just as relevant to firm performance as strategic group membership. Boyd thus convincingly shows that concepts in strategic management have to undergo continuous re-evaluation to ensure their relevance and applicability in an empirical context.

2.2 Organizational configurations and strategic types: the deductive approach

This chapter is dedicated to the deductive approach to organizational configurations. Being rooted in organizational analysis and contingency theory, this approach has a stronger focus on theory and is less occupied with empirical analysis and statistical methods than the above described inductive approach. After a general introduction into organizational configurations research, the most influential strategic typologies will briefly be presented.

2.2.1 An introduction to configurational approaches to organizational analysis

The, deductive approach to the study of organizational configurations goes back to Weber's (1947) three types of authority (traditional, rational-legal and charismatic) and their corresponding administrative structure in organizations. Basically, organizational configurations in this sense are "…multidimensional constellations of conceptually distinct characteristics that commonly occur together"(Meyer, Tsui and Hinings, 1993: 1175). Terms like "archetypes" or "gestalts" have been used synonymously in the literature. Dimensions used to categorize firms or other entities into configurations include e.g. industries, strategies, cultures, processes, beliefs or outcomes. The number of configurations within a population is limited, as attributes tend to group into coherent, jointly developing patterns. The aim of configurational research is thus to generate typologies that optimally represent the underlying structure of the particular population under consideration (Meyer, et al., 1993: 1176).

Delineating configurational research from contingency theory

The configurational approach builds on organizational analysis and contingency research. Contingency theory traditionally focuses on the fit between organizational structure and contingencies (e.g. environmental factors or aspects of strategy) (Burns, T. and Stalker, 1961; Chandler, 1962b; Donaldson, 2001). Contingency theory typically postulates a bivariate "if-then" relationship, e.g. if environmental uncertainty is high, differentiation leads to high performance – and vice versa. Obviously this model cannot cope with several co-existing environmental or organizational conditions at the same time (Miller and Friesen, 1978: 921). In contrast to contingency theory, which involves reductionistic analysis and assumes unidirectional and linear relationships among attributes, configuration theory takes a holistic perspective of entities and acknowledges non-linear relationships between variables. Patterns of organizational and environmental attributes are identified and clustered into homogeneous groups (Meyer, et al., 1993; Miller and Friesen, 1978).

Although some scholars limit the role of typologies to pure description and classification (McKelvey, 1975; Rich, 1992), most authors claim that typologies go far beyond those ends. Typologies create order by exploring the underlying structure of the observations and identifying clusters of interdependent attributes (Tiryakian, 1968: 178). Two principles guide classification systems, namely i) the idea of coherence and interconnectedness between organizational elements and ii) the holistic nature of organizational phenomena (Meyer, et al., 1993: 1181).

Typologies versus taxonomies: two streams in configurational research

Configurational approaches can further be classified into typologies and taxonomies. Examples for typologies include Weber's (1947)logic of charismatic, traditional and bureaucratic types, Burns and Stalker's (1961) distinction between organic and mechanistic forms, Mintzberg's (1979) structural typology and Miles and Snow's (1978) typology of business strategy of defenders, analyzers, prospectors and reactors. Opponents of typologies usually stress the difficulty of actually assigning organizations to types, as the theoretically derived typologies lack clearly defined cut-off points (Meyer, et al., 1993: 1182).

The term "taxonomy" is not well-defined in the literature, but the concept seems to be located somewhere between typologies and the inductive approach (strategic groups), as both inductive and deductive methods are used to establish a taxonomy (McKelvey, 1975: 1183; Meyer, et al.,

1993) (for taxonomic studies see e.g. Pugh, Hickson and Hinings, 1969; Ulrich and McKelvey, 1990). Miller and Friesen developed their organizational "archetypes of strategy formulation" by looking at both patterns *and* score-levels of organizational and environmental attributes of firms. They conducted a large-scale, cross-industry empirical study and used Q-type factor analysis to group firms by their correlation on variables (Miller and Friesen, 1978) Although taxonomies are obviously empirically derived, they differ from the concept of strategic groups as described in chapter 2.1 in at least two ways. First, taxonomic studies use theory-based variables and test their hypotheses on cross-industry data. Second, the conceptual focus of taxonomies lies on the interplay of organizational and environmental attributes that form distinct organizational profiles, whereas strategic group research is motivated by grouping firms along industry-induced mobility barriers with only a few variables (e.g. size or even financial measures).

The convergence of strategic choice and organizational ecology perspectives

Typologies in strategic management are rooted in the strategic choice-perspective, which claims that managerial decisions about a firm's actions and reactions to environmental change are important determinants of outcome variables (Child, 1972; Weick, 1979). Thus, organizations not only adapt to their environments, but can also actively influence them, although to varying extents. Typologies like Miles and Snow's (1978) and taxonomies like Miller and Friesen's (1978) have consequently found a limited number of "successful" organizational configurations. Different types represent different ways to reach organizational goals and do not necessarily differ in performance levels. However, typologies usually contain at least one "looser-type", e.g. the "Reactor" as fourth type next to Miles and Snow's "Defender", "Analyzer" and "Prospector", or Porter's (1980) "stuck-in-the middle". Likewise, several studies have found that some types perform better in certain environments, e.g. prospectors seem to be better off in dynamic environments (Zajac and Shortell, 1989).

The organizational ecology perspective, in contrast, focuses on environmental factors as main drivers of firm outcome variables. It basically holds that, within each market niche, particular types are successful and others fail (Ulrich and Barney, 1984). Zammuto (1988) found that these two seemingly conflictive approaches have arrived at similar findings on organizational configurations and successfully integrated them into a two-by-two framework with the following generic dimensions, namely i) the logic of generating sustainable competitive advantage and ii) the scope of activities. Zammuto's framework will be discussed in greater detail separately in chapter 3.4.5.

Ironically, although the deductive approach doesn't focus on performance issues, some studies have found significant performance differences across strategic types. On the other hand, strategic group research, which traditionally focuses on explaining differential performance levels within the same industry, can only offer equivocal results in empirical studies on the relationship between strategic group membership and firm profitability (see chapter 2.1).

2.2.2 Porter's generic strategies

In his seminal work „Competitive strategy – techniques for analyzing industries and competitors", Porter describes competitive strategy as "…taking offensive or defensive actions to create a defendable position in an industry, to cope successfully with the five competitive forces and thereby yield a superior return on investment for the firm" (Porter, 1980: 34). He further argues that, at the broadest level, there are three distinct, internally consistent generic strategies firms can choose from to reach this end: overall cost leadership, differentiation and focus. Although firms might pursue more than one approach to outperform competitors, commitment to one strategy is generally recommended by Porter.

To achieve overall cost leadership, a firm must focus on economies of scale, tight cost and overhead control and avoidance of marginal customer accounts while minimizing costs in R&D, service, sales force and advertising. Returns should be reinvested in new equipment and modern facilities to maintain efficiency and thus cost leadership. The pursuit of a low overall cost position usually requires a high market share and favorable access to raw materials and financial resources to build volume (see Porter, 1980: 36ff). Other resource and organizational requirements include process engineering skills, frequent reports, tight cost control, specialization of jobs and functions and incentives for quantitative targets (Grant, 2002: 247; Porter, 1980: 41).

Differentiators offer a product or a service that is perceived as unique in the industry in terms of e.g. its design, brand image, technology, features, dealer network or customer service (Porter, 1980: 37). Differentiation helps to fight competitive forces by creating brand loyalty amongst customers and lower price sensitivity, which in turn creates entry barriers for (potential) rivals as well as substitutes. A differentiation strategy calls for an emphasis on branding, design, service and quality. Consequently, the following resources and organizational skills are required: marketing abilities, product engineering skills, strong cross-functional coordination, creativity,

research capability and qualitative performance targets and incentives (Grant, 2002: 247; Porter, 1980: 41).

Focus means focusing the firm's activities on a particular buyer group, segment of the product line, or geographic market. Each functional policy should be developed with this in mind. By serving a particular, narrow target, the firm may achieve differentiation from better meeting the needs of the niche, or lower costs, or both. Firms may also use focus strategies to select niches which are least vulnerable to competitors or substitutes (Porter, 1980: 39).

Finally, a firm "stuck in the middle" lacks the resources and skills to pursue either of the above mentioned generic strategies. Such a firm "…lacks the market share, capital investment, and resolve to play the low-cost game, the industry-wide differentiation necessary to obviate the need for a low-cost position, or the focus to create differentiation or a low-cost position in a more limited sphere" (Porter, 1980: 41). In the face of competition, those firms usually show the lowest profitability in the industry.

2.2.3 Miles & Snow's strategic types

Miles and Snow (1978) essentially address the question of why and to what extent organizations within the same industry differ in their strategy, structure and processes. They find out that organizations develop relatively enduring patterns of strategic behavior that continuously align organizational features with the environment. Their theoretical framework is composed of two major elements, namely i) a general model of an effective organizational adaptation and alignment process and ii) a strategic typology that describes different patterns of adaptive behavior used by organizations within the same industry.

One of the basic assumptions of their work is that management's strategic choices shape the organization's structure and process. Miles and Snow view strategy as "a pattern or stream of major and minor decisions about an organization's structure and processes" (1978: 7). In their view, an organization's strategy can best be inferred from its behavior, although they conceptually relate strategy with intent, and structure with action. The link between strategy and structure goes back to Drucker (1954; 1974) and Chandler (1962b). Chandler discovered that a new strategy requires a new or at least adopted organizational structure to operate efficiently (Chandler, 1962b: 15). While there is no simple causal linkage between strategy and structure, successful companies seek to fit their structures to their strategies.

The proposed framework can be taken to classify organizations according to their strategic orientation and to predict with some reliability the structure and processes that come along with a certain strategy. But what exactly is meant by "strategy" within this framework? Miles and Snow use the term "strategy" to refer to long-term patterns for reacting to varying changes in the industry.

The Adaptive Cycle

Miles and Snow call the above mentioned model of organizational adaptation the "adaptive cycle", which can be broken down into the entrepreneurial problem, the engineering problem, and the administrative problem. The strategic types therefore represent alternative ways of moving through the adaptive cycle. While the defender, the analyzer and the prospector are so-called "pure" strategic types, the group of Reactors is unstable and composed of companies that fall into neither of the competitive strategic types (Miles and Snow 1978, 14).

Probably the most accurate way of describing the process of co-alignment between organizations and their environments is the "strategic choice" framework (Child, 1972). This view emphasizes the role of managers in adjusting structures and processes according to environmental conditions or even manipulating the environment to fit the organization's current activities. This approach rests on several key assumptions (Miles and Snow 1978, 20):

- A dominant coalition (top management team) exists.
- The organization basically acts upon what the dominant coalition perceives.
- The dominant coalition segments the environment.
- The dominant coalition is responsible for scanning activities.
- The company's decisions are limited by its past and current strategy, structure and performance.
- In mature organizations, the three problem sets typically appear at the same time, however they will be discussed as sequential here for analytical purposes.

The entrepreneurial problem involves the development of an entrepreneurial idea into an organizational domain by defining a specific product or service and a target market. The solution of an entrepreneurial problem is marked by top management's decision to commit resources to succeed in the newly established domain. The engineering problem is all about selecting the

appropriate technologies for producing and distributing the products. At the end of this process, an organizational system which puts into operation management's solution to the entrepreneurial problem should be implemented. The core of the administrative problem is the rationalization and stabilization of processes which have successfully tackled challenges faced during the first two phases. In this sense, the administrative system can be conceptualized as a lagging variable. However, its role as leading variable in the organizational process of adaptation is at least as important and involves the formulation and implementation of processes which enable the organization to evolve and innovate in the future. These three adaptive phases are conceptually and practically interwoven: while the process might be triggered at any point of the cycle, organizations must successfully complete the full cycle to achieve sustained competitive advantage.

Miles and Snow have found out that patterns of facing the problems described above can be condensed to four organizational archetypes, namely defenders, prospectors, analyzers and reactors. The latter will not be described in further detail as it lacks a consistent strategy-structure relationship and can be viewed as the "residual" strategic type.

Defenders – problems and solutions along the adaptive cycle

The essence of a defender's entrepreneurial problem can be described as the selection, separation and servicing of a market segment with a stable set of products and customers. Hence they chose stable and profitable market niches which they maintain aggressively by offering highly competitive prices and excellent service to loyal customers. As management concentrates on increasing efficiency in production and distribution, they only dedicate a relatively small amount of time and money to monitoring the environment. They focus on internal resources and only cautiously expand their product or market domain.

A defender's engineering challenge is essentially the efficient production and distribution of goods and services. This goal leads to the selection of cost-efficient technologies and often the focus on a single core technology which is continuously improved to increase efficiency. Defenders appear to be "lean and hungry" because of little organizational slack. Moreover, defenders have a tendency to vertically integrate in order to have tighter control and manage costs more rigorously along the value chain.

This leads directly to the administrative problem, which can be described as the maintenance of strict control to assure and increase efficiency. Hence managers in the fields of finance, management accounting and production enjoy the most powerful positions. Planning is intensive and cost-oriented. Defenders tend to be functionally organized and within functional subunits division of labor is high. Inter-unit coordination takes place by simple, cost-efficient instruments such as standardization and scheduling. Incentive systems stress efficiency increase as compared to previous years whereas external benchmarking seems less important.

Main benefits include the strong and stable position in their segment mainly as a result of efficient, well-established processes and a loyal and profitable customer base. The main detriment here is their inflexibility in the face of external change.

Prospectors – problems and solutions along the adaptive cycle

The core entrepreneurial problem of prospectors can be described as the location and exploitation of new product and market opportunities. They generally strive to be a "first-to-market company" by maintaining a reputation as innovator and change seems to be the only thing that remains constant. Prospectors embrace a broad, constantly changing market and product domain. They emphasize surveillance and decentralized scanning to spot new opportunities, which frequently makes them the creators of change in their industries. In contrast do defenders who insulate themselves from changes, prospectors take an active role in the evolution of their industries and stimulate competition. They grow primarily from new markets and/or new products and growth may occur in spurts.

Concerning engineering, prospectors first decide on *what* products to offer, and only then on *how*, that is which technologies to use. Due to their increased need of flexibility, they avoid huge investments in or commitments to single technologies. They rely on multiple, flexible technologies and rather emphasize the production of prototypes. Employees must have a variety of skills to draw on depending on the specific problem faced. Consequently, technologies are usually embedded in skilled people, not in organizational routines.

The main administrative challenge is how to facilitate and coordinate diversity. The main coalition is dominated by marketing and R&D functions and generally more transitory than the Defender's top management team. Furthermore, key executives are often hired from outside. Prospectors are frequently organized into decentralized product divisions which enjoy a lot of managerial discretion. Planning processes are intensive, oriented towards problem finding and

interwoven with experimental action and implementation. Control is basically result-oriented and decentralized, because the effectiveness of action can better be observed and assessed locally. Prospectors embrace self-control and short, horizontal feedback loops. Coordination takes place at the inter-unit level and conflict is solved directly between the individual project coordinators. Incentive systems stress effectiveness (e.g. coming up with a product that is well received in the market) over efficiency (e.g. cost savings). Performance is constantly benchmarked with similar companies rather than with own past performance.

Main detriments include a failure to achieve efficiency and thus stable profitability. Human capital is probably the most valuable resource, which may lead to inflexibility, higher human resource costs and dependency on individual experts. The system tends to underutilize or, even worse, misutilize a significant proportion of its resources and several projects never turn out to be successful.

Analyzers – problems and solutions along the adaptive cycle

The analyzer takes an in-between position on the continuum between the two extremes defender and prospector. The analyzer seeks to achieve balance between risk minimization and profitability, hence it can be perceived as a combination of the prospector and the defender type. The entrepreneurial problem is how to locate and exploit new product and market opportunities while at the same time maintaining a firm base of traditional products and customers. Analyzers have a split domain, one part being stable and the other changing. However, they never attempt to be first in the market, but rather focus on imitation of successful products through extensive marketing surveillance mechanisms. R&D is limited, applied and marketing-oriented. They grow steadily through both market penetration and market development.

In engineering, accordingly, analyzers have to be efficient in the stable part of their domain and flexible in the changing portion. Their main answer to this challenge is dual technologies, i.e. the development of an efficient technology for producing traditional products and the creation of prototypical technologies for coming up with new products and services. The applied research group is large and influential.

The administrative problem thus is all about differentiating the organization's structure and processes to accommodate both stable and dynamic areas of operation. The dominant coalition emphasizes marketing, applied research and production. Planning is intensive between marketing and production concerning the stable part of the domain and comprehensive among marketing,

applied research and product managers concerning new products and markets. Analyzers often adopt a matrix structure to accommodate these divergent needs. Control is rather centralized and budget-oriented in functional units, while it is decentralized and results-oriented in product and project groups to encourage effectiveness. Consequently, coordination mechanisms are diverse, quite complex and costly. Performance appraisal follows along these lines and is based on efficiency in stable subunits and on effectiveness (and measured against benchmark companies) in adaptive subunits.

Main benefits include low R&D investments, lower risk and better chances to achieve profitability than prospectors. However, the act of balancing between stability and flexibility at all times is very hard. A dual technology core might be very costly to adopt and sustain.

3 Theory and Hypotheses

This section represents the core of my theoretical argument. An introduction to the field and the main research questions have already been presented in chapter 0. Chapters 1 and 2 contain an overview of the theoretical concepts employed to build the following hypotheses and finally test them. After a definition of key terms, I will first discuss the concept of "fit" in strategy research as a basis for theory development. Second, I will explain the fundamental interdependence between a firm's strategic orientation and the development of its alliance portfolio. Third, I will take a closer look at how a firm's "strategic orientation" can actually be identified. Although a successful business strategy is fundamentally unique, it is possible to classify organizations into a limited number of generic "strategic types". Firms within the same strategic cluster show similar patterns of organizational characteristics (e.g. breadth of business scope, areas of preferred resource commitment, etc.). Consequently, firms in different clusters behave differently and have differing resource needs. Forth, I will discuss the concept of "alliance portfolio". In a nutshell, a firm's alliance portfolio can be described along the following dimensions: network size, network heterogeneity and tie strength. Hypotheses on the relationship between a firm's strategic orientation and its network attributes along the above mentioned dimensions will be developed. Finally, I will argue that, ceteris paribus, firms who better align their alliance portfolios with strategy will outperform those who don't.

3.1 Definition of key terms

Alliance literature has been very creative in using a wide array of terms and definitions for inter-organizational relationships. As already defined in chapter 1, **strategic alliances are "…voluntary arrangements between firms involving exchange, sharing, or codevelopment of products, technologies or services"** (Gulati, 1998: 293). This definition includes joint ventures and other equity alliances and refers to arrangements between two or more independent firms. The term "*dyadic* alliance" refers to bilateral arrangements only.

Doz and Hamel (1998) use the term "alliance portfolio" to refer to the set of dyadic alliances maintained by a focal firm. Similarly, other scholars in the field describe an "alliance portfolio" as the entire set of (or the aggregate of) strategic alliances of a particular firm (Hoffmann, 2001; Kale, et al., 2002). In a similar vein, **I define an alliance portfolio as the aggregate of all (dyadic and multi-partner) strategic alliances of the focal firm, including horizontal and**

vertical relationships to suppliers, customers, competitors or other organizations relevant for business. The alliance portfolio can thus be seen as a "snapshot" of the accumulated alliances entered into over time at a particular point in time. In referring to all direct strategic alliances of the focal firm, an alliance portfolio is distinct from the definition of "ego network", which has been used widely by network scholars and typically also includes the alliances *among* the focal firm's partners (Borgatti and Foster, 2003; Wasserman and Faust, 1994).

Another term to be defined is "alliance network", which has been used by both strategy and network scholars to refer to such diverse concepts as multi-partner alliances (Doz and Hamel, 1998; Koza and Lewin, 1999) and alliance portfolios (Baum, et al., 2000) - or simply clusters of interconnected firms (Gulati, et al., 2000). **In this research, I use the term "alliance network" to refer to a focal firm's alliance portfolio, unless stated differently in an explicit way**.

3.2 The concept of "fit" in strategy research

The concept of "fit" has been essential to theory building in strategy research (Aldrich, 1979; Fry and Smith, 1987; Miles and Snow, 1978; Van de Ven and Drazin, 1985; Venkatraman and Camillus, 1984). Authors have conceptualized "fit" in different ways, which has lead to a confusion of corresponding schemes by which the theoretical concepts of fit could be tested empirically. Venkatraman (1989) discusses the six distinct conceptualizations of fit in strategy research along with suggestions on measurement issues and testing: i) fit as moderation, ii) fit as mediation, iii) fit as covariation, iv) fit as gestalts, v) fit as matching, and vi) fit as profile deviation. The latter three will be discussed in brief, as I will consequently use them for theory building. Figure 6 shows the seven distinct concepts of fit organized along two dimensions, namely i) the degree of specificity of the theoretical relationship and ii) the choice of anchoring the specifications of the fit-based relationship. The first dimension indicates the level of precision in the functional form of the fit relationship. The second dimension tells whether the concept of fit has been specified to be intrinsically connected to a criterion variable (e.g. performance), or whether the specification is criterion-free (Venkatraman, 1989: 424).

"Fit as gestalts" is equal to the concept of organizational configurations as already discussed in chapter 2.2.1 and defined as "multidimensional constellations of conceptually distinct characteristics that commonly occur together" (Meyer, et al., 1993: 1175) or "clusters of attributes" (Miller, 1981: 5). In contrast to other concepts of fit (e.g. moderation or mediation),

gestalts involve multiple variables that occur together and produce a distinct pattern associated with a particular gestalt. Gestalts are theoretically derived and thus resemble rather the concept of "strategic types" than "strategic groups". Whereas the latter represents an empirical identification of the underlying structure of a given sample, gestalts involve some theory about the internal consistency of variables along a limited number of dimensions (e.g. Miles and Snow, 1978).

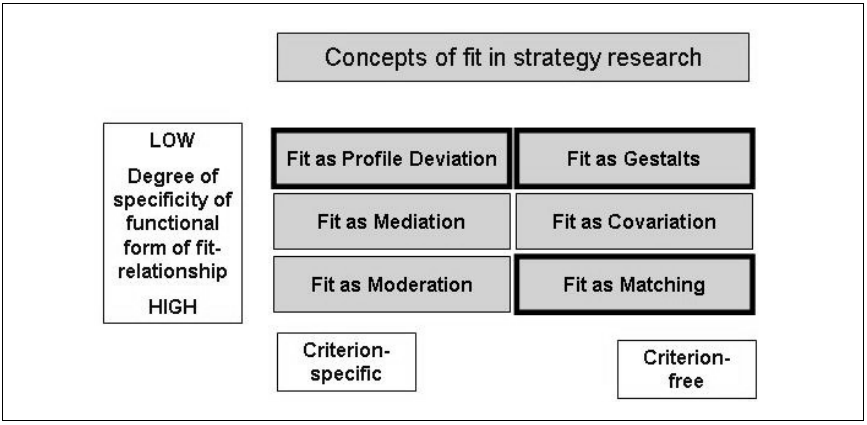

Figure 6: Mapping the six perspectives of fit. Source: Venkatraman (1989: 425).

"Fit as matching" is a commonly used concept in strategy research and specified without criterion variable (e.g. performance), although scholars typically also test the impact of fit on output measures. A famous example for this conceptualization of fit is Chandler's (1962a) perspective on the relationship between an organizations strategy and its organizational structure. Although I will not establish any strategy – structure relationship in this research, I will draw on this concept to build my propositions on the alignment of a firm's strategy and its portfolio of alliances. Venkatraman (1989: 431) discusses three somewhat related analytical schemes to empirically test fit as matching: the deviation score analysis, the residual analysis and the analysis of variance. The analysis of variance (ANOVA) has the advantage that it can be used to test other concepts of fit (e.g. moderation) as well.

Finally, I will draw on the concept of "fit as profile deviation" to conceptualize and test the impact of organizational alignment on performance. In this perspective, fit is the degree of correspondence of any given sample firm to an externally specified ideal profile (Drazin and Van

de Ven, 1985; Venkatraman and Prescott, 1990). The better the correspondence, the better should be organizational performance (Thomas, A. S., Litschert and Ramaswamy, 1991; Venkatraman and Prescott, 1990: 517). Ideal profiles can be determined either theoretically or empirically (e.g. by taking the average scores of the top 10 performers in the sample). Finally, the distance (e.g. Euclidian distance) is correlated with the selected outcome variable to test for a significant relationship between fit and the criterion variable (Thomas, A. S., et al., 1991: 517-518; Venkatraman, 1989: 434).

3.3 Linking strategy and alliance portfolio configuration

Although strategic alliances are generally perceived to enhance firm performance, they are not valuable to the firm per se. It is much more the careful alignment of a firm' strategy, strategic resource needs and the set of alliances managed that positively contributes to overall firm performance. The building blocks of this argument will be discussed in this chapter.

Business strategy and firm resources

The term "strategy" goes back to the Greek word "strategia", which means "generalship" and is formed from "stratos" (army) and "-ag" (to lead) (Evered, 1983). In state-of-the-art strategic management literature, strategy is commonly defined as the set of organizational goals and objectives along with a plan for achieving those goals, with an overall end to gain sustained competitive advantage over one's rivals (Grant, 2002: 17). Whereas corporate strategy involves the selection of industries to be active in, business strategy focuses on *how* competitive advantage can be established within a given industry. Further it is essential to distinguish between intended and realized strategies. Is a strategy formulated by managers but not fully implemented really a strategy? What if the strategy of an organization can be observed but has never been planned or implemented according to a management plan? Obviously, there are intended strategies that might be realized, or not. On the other hand, emerging strategies might be realized without ever having been planned (Mintzberg, 1978). Finally, one has to be aware of the relativity of strategy as such. Measures of strategy may not be comparable across industries. A firm that is categorized as prospector in industry A, might be a defender in (a presumably more dynamic) industry B, and vice versa. Sampling choices, particularly the heterogeneity or homogeneity of the sample, strongly influence the existing range of strategic orientations and thus the results of any clustering into strategic types (Snow and Hambrick, 1980: 531).

Depending on how business strategy is operationalized, it is more or less confounded with alliance strategy. Therefore, care is taken in this study to measure business strategy as a firm's strategic positioning on the market, that is its product/market offering including both the scope of activities and the logic of generating competitive advantage[5]. Also, this research focuses on *realized* strategy and its relationship to *implemented* alliance portfolio decisions.

Strategy development involves the careful analysis of environmental characteristics and organizational resources and skills (Drucker, 1999; Grant, 2002). Even if firms compete in the same environment, that is the same industry, their strategies might differ (see chapter 2.1 for a discussion of intra-industry heterogeneity and strategic groups). The main reason for the persistent existence of different strategies within one industry is differences in resource stocks that tend to be sustainable. For firm resources to be a source of competitive advantage, they have to be valuable, rare, difficult to imitate and difficult to substitute (Barney, 1991: 106ff). Peteraf (1993) provides an extensive model of four conditions that must be met to achieve sustained competitive advantage. Heterogeneity is a necessary but not sufficient precondition of sustained competitive advantage. Heterogeneity implies that some resources are superior, or "more valuable" relative to others and may create competitive advantage (Peteraf, 1993: 185). However, competitive advantage can only be sustained if competition is unable to duplicate the benefits of this strategy (Barney, 1991: 102). Peteraf uses the term "ex-post limits to competition" to refer to imperfect imitability, imperfect substitutability, and imperfect mobility of firm resources (Peteraf, 1993: 182-184). Dierickx and Cool (1989) identified the following factors that impede imitation: time compression diseconomies, asset mass efficiencies, interconnectedness of asset stock, asset erosion, and causal ambiguity. Focus thus shifts to the asset accumulation process as the development of resources is path dependent, i.e. dependent on prior managerial decisions and firm activities (Peteraf, 1993: 183). Such resources are not only difficult to imitate but also bound to the firm and thus imperfectly mobile (e.g. specialized supplier networks).

I use the term resources to refer to both tangible and intangible resources, although the focus obviously lies on intangible resources like experience, skills, patents, reputation and organizational culture (Edvinsson and Malone, 1997; Stewart, 1998; Sveiby, 1998). The term network resources, as discussed below and later in chapter 3.5.1, is used by strategy and network scholars mostly to refer to informational benefits derived from network relationships. In this

[5] Please see chapter 5.5.1 for more details on the measurement of strategy in this study.

study, however, I use the term "resource benefits", which includes informational benefits, access to partner skills (explicit and implicit knowledge and capabilities) as well as the potential to earn relational rents from putting together complementary resources (Ahuja, 2000a; Dyer and Singh, 1998; Lavie, 2006).

Internal resources versus network resources

Resources thus have a prominent role in both strategy formulation and strategy implementation. They facilitate or limit a firm's strategic options and, once a strategic choice has been made, play a crucial role in strategy implementation. While the traditional resource-based view focuses on internal resources of the firm as source of competitive advantage, other authors, particularly followers of social network theories, have emphasized the role of external resources, or network resources, in achieving strategic goals (Ahuja, 2000a; Andersson, et al., 2002; Baum, et al., 2000; Gulati, 1998, 1999; Gulati, et al., 2000; Jensen, 2003; Uzzi, 1996).

Obviously, external and internal resources together determine a firm's potential to gain sustainable competitive advantage over its rivals. Empirical studies have highlighted the interconnectedness and complementarity of firm resources and network resources. Lee et al. (2001) tested the influence of both internal capabilities and external networks on technology start up's performance and found several positive interaction effects. While external links do not necessarily have a positive main effect on performance, they might leverage the impact of internal capabilities – and vice versa. Absorptive capacity, the ability of an organization to evaluate and apply new knowledge, has been found to moderate the relationship between strategic alliances and output variables (Cohen, Levinthal, D.; George, et al., 2001; Tsai, 2001). In a similar vein, studies have shown that a competitive structural position of the firm supports the acquisition of heterogeneous capabilities, which in return enhances competitive advantage (McEvily and Zaheer, 1999). Bae and Gargiulo (2004) deal with the question whether partnering with resource-rich firms is actually worth the costs involved, as resource-rich firms are usually in a better position to appropriate jointly created value. The ability of a firm to process and transfer knowledge accessed via partnerships depends on its internal expertise in the specific area as well as on general knowledge management skills (George, et al., 2001: 206). Social capital supports the acquisition of external knowledge, which in turn facilitates knowledge exploitation and positively influences performance (Yli-Renko, Autio and Sapienza, 2001).

Strategic alliances and alliances networks thus play an important role for a firm's resource management and should therefore be an integrative part of a firm's strategy – or put differently: alliance portfolios should be configured and managed to support business strategy.

Alliance strategy and alliance portfolio management

In the past decades of alliance research, focus has gradually shifted from dyadic relationships to the study of multiple alliances and alliance networks (Gulati, et al., 2000; Jarillo, 1988). The study of alliance portfolios, that is the aggregate of a firm's strategic alliances at any point in time, has received increasing attention for two major reasons. First, managers and scholars alike acknowledge possible synergies as well as negative effects that arise from managing multiple alliances at the same time. Second, alliances are increasingly seen as essential instruments for strategy implementation and consequently scholars have argued for the importance of a professional alliance portfolio management and an overall alliance strategy behind individual alliance decisions (Goerzen, 2005; Gomes-Casseres, 1998; Hoffmann, 2001, 2006).

Ireland et al. (2002) argue that alliance management can be both value destroying and value enhancing, depending on the quality of alliance management processes in place. Hoffmann identifies four main tasks of alliance portfolio management: i) portfolio strategy, ii) portfolio monitoring, iii) portfolio co-ordination and iv) the establishment of an alliance management system (Hoffmann, 2005: 125). Gomes-Casseres highlights four elements of a successful alliance strategy: i) an underlying business strategy that shapes the logic and design of each individual alliance entered into, ii) a dynamic view of alliance management, iii) a portfolio approach to alliance co-ordination and iv) an internal infrastructure that supports the overall alliance management (Gomes-Casseres, 1998: 7).

Gomes-Casseres use the term "alliance strategy" to refer to some consistent concept behind all alliance activities that should be aligned with business strategy. They do not, however, differentiate between different types of alliance strategies. Hoffmann (2001) develops a typology of three distinct alliance strategies: shaping strategy, adapting strategy and stabilizing strategy. A shaping strategy involves entering into exploration alliances to develop new resources and actively shape the environment according to the firm's strategic interests. If the alliance strategy is an adapting strategy, the resource base is broadened by exploring new opportunities without making high and irreversible investments. Exploitation alliances are entered into when pursuing a stabilizing strategy to commercialize resources and stabilize the environment. Contingency

factors that determine alliance strategy are the shaping potential, that is the resource strength, of the focal firm and the strategic (environmental) uncertainty (Hoffmann, 2001: 290). Consequently, alliance strategy (at the business level) will change with the business unit's life cycle stage and its position in the market (Hoffmann, 2001: 285). Hoffmann thus links the alliance strategy of a company to both internal and external factors, though not to any specific business strategy. Generally, scholars seem to agree that alliance decisions should be backed by business strategy (Gomes-Casseres, 1998; Hoffmann, 2001). Management's focus should shift to the long-term evolution of the entire portfolio. Strategy may involve launching several alliances at the same time to pursue parallel projects to develop new products and preserve strategic flexibility. In a similar vein, pharmaceutical companies invest in several small biotechnology companies and research institutions, while at the same time continuing their internal research programs, as the chance of success of a single project is very low in the industry and big pharmaceuticals want to spread their risk (Gomez-Casseres, 1994: 9).

Despite this mutual agreement on the relevance of business strategy for decisions concerning the development and management of the alliance portfolio, there is a lack of research on how exactly business strategy and alliance portfolio configuration are interlinked, or put differently: which business strategy calls for which portfolio characteristics.

Strategic orientation, alliance portfolio configuration and performance

The contingency approach holds that maximum performance does not result from maximizing the structural variable, but much rather from fitting the structural variable to the contingency, i.e. the specific circumstances (Lawrence and Lorsch, 1967). Although contingency theory originally focuses on the fit between organizational structure and contingencies, like for example environmental factors or aspects of strategy (Burns, T. and Stalker, 1961; Chandler, 1962a; Donaldson, 2001), attempts have been made to employ the approach in the context of strategic alliance networks. There are several studies that suggest that the effect of a firm's alliance portfolio on firm performance depends on some context factor. Contingency factors in alliance studies include market conditions (Gulati and Higgins, 2003), firm nationality (Koka and Prescott, 2002), organizational structure (Geletkanycz, Boyd and Finkelstein, 2001), growth stage (Hite and Hesterley, 2001) and industry dynamics (Rowley, et al., 2000).

Geletkanycz et al. (2001) examine the relationship between CEO external networks and CEO compensation. More specifically, the study examines whether firm diversification (and thus an

elevated demand for strategic resources) moderated the relationship between CEO external networks and pay. Results show that rewards to CEO external networks are contingent upon the firm's level of diversification. In a similar vein, Gulati and Higgins (2003) discuss the contingent effects of interorganizational partnerships on IPO success. They find out that ties to a prominent venture capitalist are especially useful in cold markets, whereas ties to prominent investment banks are useful in hot markets (environment as contingency). Hite and Hesterly (2001) address the question whether cohesive or sparse networks lead to firm success. They derive propositions contingent on specific growth stages and argue that emerging firms draw on cohesive ties whereas firms in their growth phase draw rather on calculative networks exploiting structural holes.

There is a common tendency among network researchers to acknowledge that the optimal structure of a firm's alliance network depends on the firm's strategic goals (Ahuja, 2000a; Hite and Hesterley, 2001; Rowley, et al., 2000). However, empirical research has so far neglected the moderating effect of individual firm strategic orientation on the relationship between network resources and firm performance. The above discussion on intra-industry strategic diversity, strategic resource needs, and the link between strategy and alliance portfolio configuration can be summarized by the following hypotheses:

H 1: Organizations within the same industry may pursue distinctly dissimilar strategies. Organizations with similar strategies within the same industry can be clustered into a limited number of strategic types.

H 2: Alliance portfolio characteristics will vary significantly across strategic types.

3.4 Strategic types and their resource needs

As already discussed in great detail in chapter 2, there are many ways to conceptualize business strategy and thus also different approaches to measurement. Before presenting the strategic typology used in this research, I will briefly summarize major issues involved with operationalizing strategy. The typology chosen has to fit the research problem as well as the empirical setting and methods available to the researcher. Based on Miles and Snow's (1978) and Zammuto's (1988) framework, I will eventually discuss the individual types' distinct characteristics and resource needs.

3.4.1 A brief review of different operationalizations of business strategy

In the early days of strategy research, many scholars preferred textual, case-study like descriptions of strategies to any type of measurement. They argued that strategy is too situational and complex to be measured by a handful of variables (see Mintzberg, 1977: for a discussion of different views). Another group of researchers focused on single key variables like market share (e.g. Chevaller, 1972; Fruhan, 1972) or indicators of functional areas like R&D and marketing (e.g. Udell, 1972) and their impact on firm profitability. Although most of these authors didn't claim to measure "strategy" in their studies, they generally positioned themselves within the strategy field. Obviously, the implications of these studies are limited as the breadth of decision areas that constitute business strategies cannot be captured by a single variable. However, they provided the foundations for scholars who were interested in the multivariate measurement of strategy (Hambrick, 1980). Consequently, scholars generated inventories of key strategic variables and tested their relationships with output variables, typically performance (e.g. Hatten, et al., 1978; e.g. Schoeffler, Buzzell and Haeny, 1974). In the famous PIMS studies, scholars studied the relationships between two or three key variables and return on investment (Buzzell, Gale and Sultan, 1973; Schoeffler, et al., 1974). At that time, a group of scholars rooted in the industrial organization (IO) theory explored intra-industry heterogeneity and came up with the concept of strategic groups to describe firms characterized by distinct strategic attributes, particularly barriers to entry (McGee and Thomas, 1986: 142). These studies typically focused on a single industry and aimed at empirically deriving a set of clusters (strategic groups) based on mostly industry-specific key variables (Caves and Porter, 1977; Cool and Schendel, 1987; Hatten and Schendel, 1977; Hatten, et al., 1978). Studies on the implications of strategic group membership on performance variables offer only equivocal results (see e.g. Cool and Schendel, 1987), a fact that fostered criticism towards this inductive approach of generating strategic groups. Despite of the multivariate nature of this conceptualization of strategy, scholars increasingly criticized the lack of a theoretical foundation of the variables used in the empirical studies and their focus on statistical methods (Ketchen, D. J., et al., 1993; McGee and Thomas, 1986; Thomas, H. and Venkatraman, 1988). Yet another way to operationalize strategy is the deductive, typological approach that is characterized by its degree of comprehensiveness and its focus on the distinct pattern of organizational attributes that vary across strategic types. The most prominent typologies are arguably Miller and Friesen's (1978) archetypes of strategy formulation, Miles and Snow's (1978) strategic types and Porter's (1980) generic strategies. These approaches share a common interest in the overall, multivariate profile of a given strategic

type and the holistic nature of organizational phenomena (Meyer, et al., 1993: 1182). Miller and Friesen's archetypes are also referred to as "taxonomy" and differ slightly from Porter's and Miles and Snow's typologies in that they use both inductive and deductive methods to establish the taxonomy and that the archetypes are eventually derived empirically. However, taxonomic studies typically use cross-industry data on focus on the interplay of organizational and environmental attributes, whereas strategic group research is limited to the specific industry setting and the analysis of industry-induced mobility barriers (McKelvey, 1975; Meyer, et al., 1993; Miller and Friesen, 1978).

3.4.2 A synthesis of Miles and Snow's typology

Based on the "strategic choice" perspective (Child, 1972), Miles and Snow's (1978) typology of prospectors, analyzers, defenders and reactors is arguably the most widely used typology in strategy research (for empirical and theoretical evidence see e.g. Boyd, B. and Salamin, 2001; Hambrick, 1983; Ketchen, D. J., et al., 1993; Shortell and Zajac, 1990)[6]. Miles and Snow view strategy as an organization's long-term pattern of reacting to changes in the industry. They find that organizations develop relatively enduring patterns of strategic behavior to align internal features with the environment, and that those patterns of adaptive behavior differ across strategic types – even within the same industry. The strategic choice perspective views strategy as "…a pattern or stream of major and minor decisions about an organization's structure and processes"(Miles and Snow, 1978: 7). The strategic choice perspective thus emphasizes the role of managerial decisions in adjusting structures and processes according to environmental change. The "adaptive cycle" consists of three areas of adjustment, that is the entrepreneurial problem (product/market decision), the engineering problem (technology selection) and the administrative problem (implementation of supportive processes).

Miles and Snow found that patterns of coping with these "problems" can be grouped into four strategic types: defender, prospector, analyzer and reactor (the latter represents a "residual" type as it lacks consistent characteristics and can thus not be used for deriving propositions). Prospectors focus on entrepreneurial tasks, new product development and typically have outstanding expertise in marketing and R&D. In contrast, defenders are engineering-oriented, concentrate on improving efficiency and maintaining a secure niche in relatively stable market

[6] See also chapter 2.2.3 for an extensive discussion of Miles and Snow's framework.

segments. Analyzers run a selective strategy and are more complex and functionally balanced. In stable environments, they act rather like defenders striving for efficiency, whereas in dynamic contexts, they continuously watch competitors and selectively adopt innovations with a strong market potential (Conant, Mokwa and Varadarajan, 1990). The primary dimension underlying Miles and Snow's typology is the "orientation towards change" (Boyd, B. and Reuning-Elliott, 1998; Boyd, B. and Salamin, 2001; Shortell and Zajac, 1990), also referred to as "product-market change" (Hambrick, 1980: 570), with prospectors representing one extreme (that is strong orientation towards change) and defenders the opposite end of the continuum.

3.4.3 Comparing Porter's generic strategies and Miles and Snow's framework

Hambrick (1983) compares Porter's generic strategies to Miles and Snow's framework and observed that the two typologies are not contradictory and that their differences simply point to the fact that business strategy is a complex construct which cannot easily be turned into a classification system that hold across industries and under all circumstances. He points out that prospectors can be compared to differentiators, defenders to cost leaders or another type of differentiators, and organizations stuck-in-the-middle to reactors. Obviously, these typologies share quite a few similarities. Both typologies were developed for business-level strategy (as opposed to corporate-level strategy). They offer more than a simple cluster analysis by providing clear descriptions of common forms of competitive behavior and recognize that different types can be equally successful if they are applied effectively (Ketchen, D. J., 2003: 100-101). Segev (1989) integrates these two typologies by assigning values of 31 strategic variables to all strategic types and consequently maps them along the dimension "level of proactiveness" in the following order (from high to low levels of proactiveness): prospectors, differentiation or differentiation focus, analyzers, cost focus, cost leadership, and finally defenders (Segev, 1989: 97).

However, there is difference in focus between the two approaches. Whereas Porter's typology is a "true strategy typology in the sense that it identified common forms of strategic intent" (Ketchen, D. J., 2003: 100), Miles and Snow's framework can rather be viewed as an organizational typology, since strategic orientation is described together with structure and processes necessary to pursue the respective strategy. While both typologies are similar in their descriptions of market/product orientation, Porter's conceptualization of strategy is purely market oriented and focuses on market activities essential to pursue a given strategy. Miles and Snow's approach to strategic orientation is wider as it includes a rich description of the respective

organizational structure and managerial processes (Hambrick, 2003; Ketchen, D. J., 2003: 100). Thus, Miles and Snow's is recommended for organizational analysts and for strategy scholars that seek to make predictions about organizational structure or other organizational attributes based on the firm's strategic orientation. However, researchers may only test for the link between strategic types and other variables that did not constitute the basis for classification in the first place (Hambrick, 1980: 570).

3.4.4 A critical assessment of the applicability of Miles and Snow's typology today

Miles and Snow's framework is still widely used and further developed in contemporary strategy research (Dvir, Segev and Shenhar, 1993; Goshal, 2003; Hambrick, 2003; Veliyath, Ferris and Ramaswamy, 1994). Conant et al. (1990) develop and field-test a multi-item scale for Miles and Snow's typology and present an excellent review of the large number of previous studies and operationalizations of the framework. However, other studies have found that empirically derived solutions based on an adapted version clearly dominate the traditional typology of defenders, analyzers and prospectors (Desarbo, et al., 2005). Also, the analyzer type has been criticized for being to generic in the sense that in reality almost all firms are analyzers (Ketchen, D. J., 2003: 101).

Obviously, the typology is old and a lot has changed in the business world since 1978, such as dramatic innovations in information technology, the deconstruction of value chains and the re-definition of entire industries along with outsourcing and alliance activities. The share of highly specialized firms is growing, especially in dynamic and innovation-driven industries. Business models are turned upside down as previously fully integrated companies become flexible networks of business units and partner firms. How do these new organizational types fit into the traditional typology? In a recent interview conducted by David J. Ketchen Jr., Ray Miles and Charles Snow express their opinions on some of these issues. "What we are currently interested in is whether entrepreneurship can be a sustainable strategy. That is, is it possible to assemble knowledge and other resources in such a manner that innovation can become a continuous process and that the results of innovation can be continuously utilized? We don't think this is likely to happen within a single firm, but it could and will happen within a network of firms sharing a common knowledge base and a commitment to using it in a collaborative manner (Ketchen, D. J., 2003: 100). Likewise, they say that they expect a new generation of "prospecting network" to emerge that behaves like an entrepreneur, continuously generating new products *and*

markets by sharing resources across industries. I see this vision already realized in e.g. contemporary R&D networks and knowledge clusters. Boyd (2004) successfully combines the concept of strategic groups with the concept of strategic blocks and shows that more accurate predictions of performance differences can be derived through an integrated approach. Strategic blocks are strategic networks of companies closely tied to each other by multiple strategic alliances. In today's networked business world, strategic block membership might be just as relevant to firm performance as strategic group membership. Boyd convincingly shows that concepts in strategic management have to undergo continuous re-evaluation to ensure their relevance and applicability in an empirical context.

To sum up, while the Miles and Snow typology has many advantages (e.g. it is the most widely used strategic typology, it has been operationalized and tested in many ways, it has high "face" validity and it includes rich descriptions of organizational structure and processes that go with the respective strategy), it doesn't seem to represent (anymore) the major strategic options firms have in today's business world. While Zammuto's (1988) framework has not – by far – received the attention of Miles and Snow's typology, it has good answers to the above mentioned issues. First, it includes a fourth type, the entrepreneur. Second, the two-dimensionality of Zammuto's framework makes it easier to measure and ultimately to describe the clusters derived. Third, the analyzer type becomes more than just a middle way between prospector and defender. Consequently, I will "borrow" Zammuto's fourth type, the entrepreneur, for deriving my hypotheses. Also, I will draw on both typologies to generate adequate measures. This approach is viable because defender, analyzer and prospector types correspond in both frameworks (see Table 1 and Figure 7).

3.4.5 Zammuto's framework

Whereas followers of the organizational ecology perspectives (Aldrich, 1979; Hannan and Freeman, 1977; McKelvey, 1982; McKelvey and Aldrich, 1983) argue that organizational form, function, strategy and output variables are determined by external, environmental conditions, students of the strategic choice approach (Child, 1972; Miles and Snow, 1978; Pfeffer and Salancik, 1978) hold that any output is affected by managerial decisions (Astley and Van de Ven, 1983: 253). Zammuto (1988) identifies a significant correspondence between the organizational ecology and strategic choice perspectives on strategic typologies. He develops an integrated framework and points out how the organizational ecology perspective can mitigate some of the

major shortcomings of strategic choice theory. More precisely, the organizational ecology perspective helps to understand why some strategic types are more successful than others under certain conditions and why the mix of strategic types within an industry changes over time (Zammuto, 1988: 105).

The organizational ecology perspective on strategic typologies

"The concept of strategy in organizational ecology focuses on how organizations within a population exploit resource opportunities in a niche, and under what conditions environmental selection favors different exploitation strategies" (Zammuto, 1988: 106). A niche is the aggregate of resources, demand and constraints that both facilitate and limit the scope of action and the profitability of organizations populating the niche. For the purposes of his framework, Zammuto defines the niche at the industry level – as opposed to the concept that an industry comprises several niches. Naturally, niches are shaped by various environmental factors such as technological change, government regulations and changing consumer tastes. Within this perspective, strategy is defined along two dimensions, that is i) the scope of organizational activity and ii) the way organizations exploit resource opportunities within their scope.

Along the first dimension, "specialists" have narrow domains and "generalists" have a wider range of activities or products (Aldrich, 1979). The second dimension, resource exploitation, is discussed in detail by Brittain and Freeman (1980), who describe two extremes of exploitation strategies: r-strategies and K-strategies. This classification stems from the biological literature and is based on a logistic model of population growth within a niche. Essentially, the logistic model (S-shaped curve) shows how the growth of a population is initially slow, then proceeds at an exponential rate and finally slows down over time as the maximum capacity in the niche is reached[7]. Consequently, the success of strategies for resource exploitation is a function of the extent to which a niche is already filled. At the initial stage, organisms reproducing quickly have an advantage over their peers, but as the density of the population increases, efficient competition for resources becomes more important than reproduction (Zammuto, 1988: 108). Brittain and Freeman apply these findings to the strategic management literature and define the opposing strategic types of organizations as follows: r-strategists are organizations that move quickly to exploit new resource opportunities; they expand into new business fields and benefit mostly from

[7] Zammuto (1988) briefly describes the model in his article before he presents his integrated framework of strategic types. For a more detailed description of the curve and related empirical findings see e.g. (Eighmy and Jacobsen, 1980).

their first-mover advantage. Consequently, r-strategies are favorable in low-density environments, where resources are highly dispersed over time and space and not readily available. K-strategists specialize on using existing resources more efficiently. They outperform r-strategists in densely populated niches. Finally, if combined with the distinction between specialists and generalists, a two-by-two is created with the following types: r-specialism, r-generalism, K-specialism and K-generalism (Brittain and Freeman, 1980).

Integration with Miles and Snow's typology as major representative of the strategic choice perspective

As a representative of the strategic choice perspective, the Miles and Snow (1978) typology has had a major impact on strategy research since its publication (Zammuto, 1988: 110). As the basics of the strategic choice perspectives are fundamental elements of mainstream strategy research, the literature will not be reviewed in further detail at this point (see e.g. Child, 1972; Pfeffer and Salancik, 1978). In contrast to the ecological perspective, the strategic choice perspective explores and describes how management decisions shape organizational strategy, structure and processes. The basic assumption here is that consistency between strategy, structure and processes should enhance firm performance. Whereas this is the case with analyzers, defenders and prospectors, reactors will not be included in the following framework as they lack consistency (for a detailed description of the Miles and Snow typology see chapter 2.2.3).

Zammuto integrated the ecology perspective (Brittain and Freeman, 1980) with strategic choice theory (Miles and Snow, 1978). Whereas he didn't include the reactor in the framework, he added one type which is not originally included in the Miles and Snow framework: the entrepreneur, or "type I" organization (Fouraker and Stoppford, 1968). "Type I…This structure is generally limited to a single product line and often emphasizes one function (e.g. production) more than others. It is also constrained by the sequential decision-making pattern that characterizes a single problem solver. This is the entrepreneurial business organization…" (Fouraker and Stoppford, 1968: 48). Table 1 shows the high correspondence between ecological and strategic choice perspectives of strategic choice by directly comparing the respective descriptions of the four types. Figure 7 finally presents Zammuto's (1988) integrated framework as a synthesis of the two approaches.

STRATEGIC TYPE	Brittain and Freeman, 1980	Miles and Snow, 1978 (entrepreneur: Fouraker and Stopford, 1968)
Defender K-Specialist	The K-specialist operates very efficiently within a narrow domain.	The defender's product-market domain is narrow and stable, products and services are directed to a limited segment of the market. Defenders pursue technological efficiency and efficiency in all other processes to compete on either price or quality.
Analyzer K-Generalist	The K-generalist engages in a wide scope of activities and relies on efficiency as the preferred mode of competition. The K-generalist follows the r-type organization and relies on market penetration and efficient production.	The analyzer's domain is a mix of products and markets, some stable, others not. Analyzers move quickly toward a new product or market that has already been opened (second-mover).
Entrepreneur r-Specialist	The r-specialist pursues a strategy of exploiting new resource opportunities in a relatively unpopulated nice within a narrow domain of activity.	The entrepreneur is often owned by the founder and limited to one or few products lines and functions. It is the typical "start-up" organization.
Prospector r-Generalist	The r-generalist moves quickly to exploit new opportunities, but over a broader range of activities.	The prospector's major skills lie in finding and exploiting new market opportunities (first-to-market). Its domain is broad and in constant change.

Table 1: Correspondence between the ecological and strategic choice perspectives.

The integration of these two perspectives seems reasonable for the following reasons: The ecology perspective helps to understand why some strategic types are more successful than others in certain environments and why the distribution of strategic types within an industry might change over a large period of time. Even Miles and Snow acknowledge that, although theoretically all types should be found in any industry at all times, their mix will vary depending on industry dynamics and the life-cycle stage of the market (Miles and Snow, 1986: 67). It is even argued that a flexible mix of types is necessary for the development of a healthy industry. Entrepreneurs and prospectors are responsible for state-of-the-art innovations, analyzers search those innovations for marketability and efficient manufacturing opportunities, and defenders focus on lowering costs and targeting mass markets (Zammuto, 1988). In this way, organizations play their distinct role in the industry's recurring cycle of innovation and standardization. The concept of density-dependent strategies also sheds light on why and how changing environmental conditions affect the strategies' relative success. Apart from environmental changes, the

transformation of organizations (e.g. through vertical integration, acquisitions, diversification, etc.) also may lead to changes in the distribution of strategic types (Zammuto, 1988: 117).

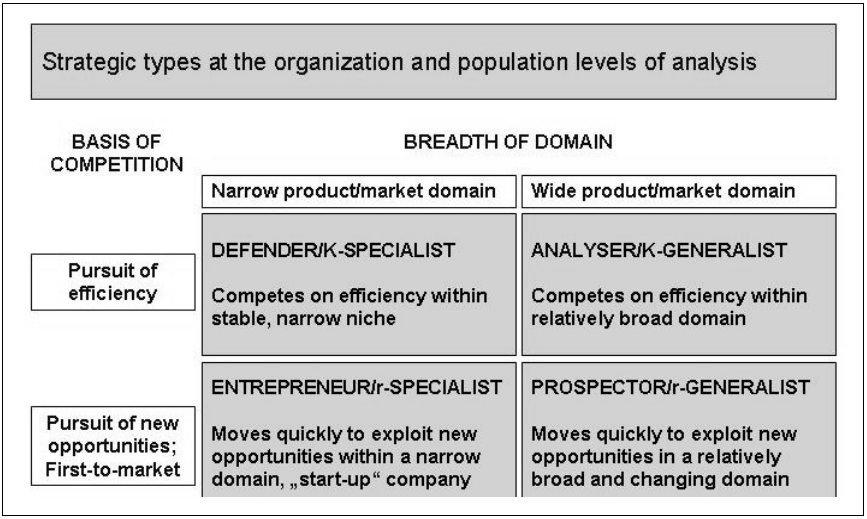

Figure 7: Zammuto's (1988) integrative framework of strategic types.

3.4.6 Strategic types – characteristics, capabilities and resource needs

Although the following description of strategic types is primarily based on Miles and Snow's (1978) strategic typology, it also incorporates aspects of the organizational ecology perspective. I have chosen Miles and Snow's framework as starting point as it involves a rich description of not only business strategy but also processes, structure, organizational capabilities and resource needs that go a long with a particular strategy. In addition, I draw on Zammuto´s framework (see Figure 7 and Table 1) to add a second dimension to the classification (narrow versus wide scope of activities) and to include the entrepreneur as fourth strategic type (Brittain and Freeman, 1980; Fouraker and Stoppford, 1968; Zammuto, 1988).

Prospectors' main challenge is to locate and exploit new products and market opportunities. Their success depends on growth strategies and the so-called "first mover" advantage. Prospector's typically have above average marketing capabilities and/or capabilities in research and development and information technology (Conant, et al., 1990; Desarbo, et al., 2005). They are less experienced with building enduring market relationships, that is customer relationship

management, customer retention and supplier relationship management (Desarbo, et al., 2005). In engineering, they seek to avoid long-term commitments to single technological processes. They usually employ multiple technologies at the same time and work with a low degree of routinization and mechanization. Prospecting organizations invest in a broad developing domain, monitor a wide range of environmental conditions and events and grow through product and market development (Miles and Snow, 1978). Consequently, prospectors need large amounts of novel and up-to-date information on market and technological developments. They will highly benefit from ad-hoc access to partner resources and will pursue a relatively large amount of diverse options via partnerships to spread risk and keep one foot in the door with respect to innovations and trends in their industry. Prospectors will access network resources both to leverage internal resources and to compensate for non-sufficient internal resources in a specific area.

Defenders generally build on stable sets of products and customers as a small portion of the total market. They focus on exploitation of existing resources and capabilities and develop new products only if closely related to current goods and services. They have relatively pour marketing skills (Conant, et al., 1990), but tend to be experienced in relationship management and building durable relations to both customers and suppliers (Desarbo, et al., 2005). They also stick to more conservative management teams and compensation systems (Thomas, A. S., et al., 1991; Veliyath, et al., 1994). Defending organizations strive for efficiency in production and distribution of their products, which involves cost-efficient technologies and strong partnerships or even vertical integration. Defenders need reliable, fine-grained information and a stable, trustful relational culture. They need to build long-lasting, intimate relationships to their customers and suppliers in order to exploit existing resources, leverage internal competences and fine-tune joint efforts in development, production and distribution.

Analyzers locate and exploit new product and market opportunities while simultaneously maintaining a firm base of traditional products and customers (Miles and Snow, 1978). They score relatively high on marketing skills and especially management capabilities (Desarbo, et al., 2005: 57). They typically grow steadily through market penetration and product-market development. They build on dual technologies (stable and flexible components) and have moderate degrees of technical efficiencies. Such companies need diverse resources as they engage in stable niches while at the same time imitating successful prospector strategies. Therefore analyzers need a diverse network and a moderate number of relationships to account

for their heterogeneous resource needs while keeping up low to medium levels of relationship quality. On a continuum, their network dimensions are expected to score between prospectors and defenders.

Entrepreneurs pursue strategies of exploiting new resource opportunities in a relatively unpopulated niche within a narrow domain of activity. They will be first to adapt to environmental change and may even actively promote change and shape the environment within their area of expertise (Zammuto, 1988). The entrepreneur is typically a start-up organization driven by only few, but highly skilled and committed people. Entrepreneurs are flexible and can forcefully move into target areas without being constrained by bureaucratic and other organizational burdens (Fouraker and Stoppford, 1968: 48; Miles and Snow, 1978: 118). Due to their limited resources and experience they will highly benefit from access to external resources. Entrepreneurs will, therefore, build a large network (relative to their size) of rather homogeneous alliances. Moreover, they will seek to build trust and commitment among the participants to enhance information exchange and efficient cooperation.

3.5 Alliance portfolio configuration

The core argument of this paper is that organizations (should) align their portfolio of strategic alliances with their business strategy. This section lays out my central hypotheses concerning the relationship between strategic orientation and network configuration. I will discuss a firm's alliance portfolio along three distinct dimensions that involve structural, relational and partner-related characteristics. The underlying assumption is that different portfolio configurations bring about very different resource benefits. First, the alliance portfolio construct will be developed based on existing theory. Next, portfolio characteristics will be described along three dimensions, that is i) network size, ii) tie strength, and iii) network heterogeneity. The quality and quantity of resource benefits derived from alliances will depend on how a given portfolio scores along those three dimensions. Finally, I will develop propositions concerning the network configurations of the respective strategic types. I expect prospectors, defenders, analyzers and entrepreneurs to differ significantly on the above mentioned portfolio characteristics.

3.5.1 The alliance portfolio: a multi-theory concept

Despite of growing empirical evidence of the positive impact of alliance networks on firm performance, few studies have actually made the attempt to develop a construct for the aggregate of a firm's strategic alliances. The alliance network of a focal firm is still a vague concept and is sometimes referred to as "network resources" (Ahuja, 2000a; Gulati, 1999; Jensen, 2003), "social capital" (Koka and Prescott, 2002; Yli-Renko, et al., 2001), "external network" (Andersson, et al., 2002; Lee, Ch., et al., 2001), or simply "network" (Hite and Hesterley, 2001). Authors have used different terms to refer to the configuration of a focal firm's alliance network, such as "alliance network structure" (Bae and Gargiulo, 2004), alliance network composition (Baum, et al., 2000), "alliance network configuration" (Lavie, 2004) or "dimensions of social capital" (Koka and Prescott, 2002). While studies rooted in social network theory use measures such as the number of direct and indirect ties, structural holes, density, centrality or tie strength as independent variables to predict the output variable, authors relying on resource-based arguments typically use measures of partner characteristics and capabilities (Bae and Gargiulo, 2004; McEvily and Zaheer, 1999). I will draw on the notion of network resources (Ahuja, 2000a; Gulati, 1999; Gulati, et al., 2000) to explore the construct and define three distinct dimensions of alliance network configuration that determine which kind of resources the focal firm will eventually obtain via its network.

The concept of network resources builds on both the resource-based view and social network theories, particularly on the concept of "social capital" (Bourdieu, 1986; Coleman, 1988)[8]. Although the term "social capital" was originally used to refer to an individual's network of social relationships, strategy scholars have increasingly employed it in the context of strategic alliance networks. In line with Inkpen and Tsang's (2005: 151), **I define the social capital of a firm as the aggregate of resources embedded within, available through, and derived from the network of interfirm relationships possessed by a firm.**

Within the social network literature, a common approach to describe social capital is along three dimensions – a structural, a relational, and a cognitive dimension (Inkpen and Tsang, 2005; Nahapiet and Goshal, 1998). Koka and Prescott (2002) view the alliance portfolio of a firm as social capital and conceptualize it as a construct that yields three distinct informational benefits: information volume, information diversity and information richness. Information volume is

affected by the number of partners and ties, information diversity depends on technological diversity, country diversity and structural holes, and information richness is captured by counting multiplex and repeated ties (Koka and Prescott, 2002: 799).

Network resources inhere in interfirm networks and are thus distinct from resources that reside within a firm's boundaries. The amount of such resources can influence a firm's opportunities and strategic behavior. Gulati (1999) conceptualizes the informational benefits derived from network membership as network resources. Furthermore, he holds that the "…network resources firms can receive from their participation in interfirm networks is akin to the social capital of individuals" (Gulati, 1999: 400). From a resource-based perspective, a firm's network of relationships is thus an opportunity to access and/or create inimitable value generating resources. First, a network provides the firm with access to key resources (e.g. capital, information, services, know-how, etc) and is usually idiosyncratic, created through path dependend processes and hard to imitate by rivals. Second, the resources themselves are typically created jointly and/or in path dependent processes and thus hard to imitate or substitute (Gulati and Gargiulo, 1999). Gulati et al (2000: 207-208) show that three dimension's of a firm's network can serve as a sources of sustainable competitive advantage. *Network structure* is highly path dependent and allows the focal firm to distinguish it from rivals. *Network membership* per se is hard to imitate and thus a persistent source of competitive advantage. The existing mix of partners (that is partner types available, partner diversity, etc.) impacts the pool of resources available to the firm and also influences future partner choices (Gulati, 1999). *Tie modality* describes the nature of the tie, that is, if the relationship is strong or weak, characterized by opportunism or cooperation, reluctance or commitment. Several empirical studies have found a significant relationship between tie strength and performance outcomes (Dyer, 1996).

Koka and Prescott do not explicitly mention the term network resources. However, they define social capital similarly to how Gulati (1999) defines network resources, i.e. "in terms of the informational benefits available to a firm due to its strategic alliances" (Koka and Prescott, 2002: 795). In the context of this research, I define **network resources as the resource benefits available to a firm due to its portfolio of strategic alliances.** This definition includes, but is not limited to, informational benefits. The resource benefits obtained by the focal firm depend on the quality, quantity and diversity of resources that flow in via the network. Hence I will distinguish

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[8] Please see chapter 1.4.3 for a more detailed discussion of the concept of social capital and early research on network resources.

three distinct dimensions to describe a firm's alliance portfolio, that is i) network size, ii) network heterogeneity and iii) tie strength.

3.5.2 Network size

Network size is determined by the number of alliances and the number of alliance partners. A large alliance network is associated with good access to resources, especially information and know-how (Ahuja, 2000a; Baum, et al., 2000; Powell, et al., 1996). In empirical studies alike, the number of alliances is often taken as a measure for the quantity of resources that can be accessed via partners (Powell, et al., 1996; Stuart and Podolny, 1999). Network scholars have specifically highlighted the positive effects of network size on innovation output (Ahuja, 2000a; Powell, et al., 1996), growth and performance of organizations in dynamic industries and start-up companies (Baum, et al., 2000; Powell, et al., 1999), as well as the future number of alliances and overall network development (Gulati, 1999; Powell, et al., 1996).

The quantity of resources accessed is a key topic in studies relating a firm's central position to some positive organizational outcome (Koka and Prescott, 2002; Powell, et al., 1996; Powell, et al., 1999). Centrality can be conceptualized as degree-centrality, which is the number of direct links a company has with other players (Hanneman and Riddle, 2005). Actors who have more direct ties than others are in an advantageous position because they are less dependent on individual sources of supply. Firms with a high degree-centrality should be more influential than others, not just because of the larger amount of resources accessed per se, but even more so because they have more options, are more flexible, spread their risk and have a better overview of product and market developments. Therefore, firms that are characterized by a strong orientation towards change and the pursuit of new opportunities should have more strategic alliances (relative to their size) than their efficiency-oriented peers.

H 3 a/b/c/d: Prospectors and entrepreneurs will have larger networks (relative to their size) than defenders and analyzers.

3.5.3 Network diversity

The main argument here is that a mere accumulation of ties is not necessarily beneficial (and can be very costly indeed) unless a marginal contact adds novel, i.e. non-redundant resources to the portfolio (Burt, 1992; Goerzen and Beamish, 2005; Koka and Prescott, 2002; McEvily and

Zaheer, 1999). A company has to find out who can provide them with the necessary information and then focus on a few diverse sources of information. “Size is a mixed blessing…What matters is the number of nonredundant contacts. Contacts are redundant to the extent that they lead to the same people, and provide the same information benefits” (Burt, 1992: 17). A structural hole is the separation between nonredundant contacts. The empirical conditions that indicate a structural hole are the absence of cohesion and structural equivalence. Arguably Granovetter (1973) was the first to discuss this issue, however he focused on tie strength and not structure. He developed his original argument by studying the relationships of individuals looking for a job and found that it is actually “weak ties”, i.e. distant acquaintances that usually bring about the greatest benefits when looking for a job. However, “the causal agent in the phenomenon is not the weakness of a tie, but the structural hole it spans” (Burt, 1992: 27). Burt’s argument has lead to a frequent use of measures like “network sparseness” and “structural holes” as proxies for information diversity – which is what should actually be grasped. Rodan and Galuncic (2004) successfully unpack the correlation between structural holes (network structure) and resource heterogeneity (network content). Whereas the correlation 0.21 between these constructs is significant ($p<0.05$), there is no guarantee that a sparse network also means variety in the information sourced. Partner heterogeneity (e.g. technological diversity, national diversity) therefore seems to be an appropriate way to operationalize the construct.

Empirical studies have so far largely supported the positive relationship between network heterogeneity and the acquisition of novel information and nonredundant resources. Specifically, authors have highlighted the positive impact of network heterogeneity on innovation output and learning (e.g. measured as patent count or the share of radically new products to total products), especially in dynamic industries and/or with respect to entrepreneurial firms (Ahuja, 2000a; Baum, et al., 2000; Powell, et al., 2004; Stuart and Podolny, 1999). Bridging ties have been found to be a critical source of firm heterogeneity and competitive capabilities (McEvily and Zaheer, 1999) and may support the ad-hoc acquisition of resources and capabilities if not available internally (Branzei and Thornhill, 2006; Soda and Zaheer, 2004). Internal capabilities generally seem to moderate the relationship between network structure and firm performance, i.e. a favourable network structure and innovative partner capabilities can better be exploited by innovative firms (Zaheer and Bell, 2005). However, not even this relationship holds true in all cases. Branzei and Thornhill (2006) find that, in stable environments, heterogeneous R&D networks help both leaders and laggards and act as substitute for a shortage of internal resources.

In dynamic environments, however, only leaders seem to benefit, and so in direct proportion to their internal value creating capabilities.

Interestingly, some empirical studies have also found decreasing returns form network diversity (Goerzen and Beamish, 2005; Powell, et al., 1999). Possible drawbacks of network diversity include high costs, lower levels of trust and lower quality of information. Benefits of more homogenous networks involve lower costs and generally the ability to concentrate better on strong ties where value creation takes place. To sum up, network heterogeneity contributes to the acquisition of novel information and can significantly boost performance, specifically due to better innovation output. However, managing a heterogeneous network requires relatively high resource commitment, network management skills and absorptive capacity of the focal firm. Therefore, it seems likely that only relatively large, diversified firms can "afford" to sustain a heterogeneous network.

H 4: a/b/c/d: *Prospectors and analyzers will have, on average, more diverse networks than defenders and entrepreneurs.*

3.5.4 Tie strength

This dimension refers to a firm's relational embeddedness. An embedded tie, or "strong" tie, is an intimate relationship between the firm and its alliance partner. Embedded ties facilitate economic exchange via three main mechanisms, i.e. trust, fine-grained information transfer, and joint problem solving arrangements (Uzzi, 1996). Strong ties are the opposite of so-called arm's length relationships. Marsden and Campbell (1984: 1361) argue that "the strength of a tie is a combination of the amount of time, the emotional intensity, the intimacy and the reciprocal service which characterize the tie". More precisely, strong ties are reported to provide two main advantages. First, they are associated with the exchange of high quality information and fine-grained, tacit knowledge (Uzzi 1996) and create value because partners make relation-specific investments, implement knowledge-sharing routines and use effective governance mechanisms (Dyer and Singh, 1998). Second, strong ties govern partnership behaviors as they promote trust and reciprocity, learning and often turn out to be more efficient governance mechanisms than formal contracts (Kogut 1988, Macaulay 1963, Uzzi 1996). Information obtained through strong ties tends to be more relevant and more detailed ("fine-grained") than information flowing through weak ties.

Whereas there is a lot of support for the proposition that strong ties are beneficial, there is also empirical evidence that weak ties bear certain advantages, i.e. they lead to novel information and serve as "bridges" to more distant others possessing different know-how (Granovetter 1973). Drawbacks of strong ties include high costs, outdated information and short-term orientation (Hakansson and Snehota, 1998; Rowley, et al., 2000). Weak ties, on the other hand, offer contrary benefits and detriments. They tend to provide access to novel information (Granovetter, 1973) as they are more likely to be "local bridges" to quite different firms than strong ties. Weak ties are much less costly and help the organization to stay flexible in a dynamic environment.

How should firms be embedded in their industry network? Some scholars argue that firms have to find the "right mix" of strong and weak ties. Uzzi (1997: 60) suggests that firms should compose their 1st order network (direct contacts) of mostly strong ties, and their 2nd order network (indirect contacts) of a good mix of both types. Others go even further and argue for a contingency approach to network configuration. Rowley et al. (2000) posit that relational and structural embeddedness can only be understood with reference to each other and that their impact on performance is contingent upon industry dynamism (explorative versus exploitative industry). The study suggests that strong ties and dense structures act as alternative governance mechanisms and that their joint use is inefficient. Furthermore, strong ties or dense structures are found to be more beneficial in exploitative settings, whereas weak ties or sparse structures support performance in explorative settings. Hoffmann, however, posits that innovation and "shaping" strategies call for rather strong ties to partner firms (Hoffmann, 2001: 167). Especially focused R&D alliances need to be strong ties in order to work, as trust, commitment and the exchange of high quality information is essential for positive innovation outcomes.

To sum up, the usefulness of strong ties seems to depend on the firm's scope of activities, and not so much on its orientation towards change and innovation. Firms focused on only few areas of activity draw on strong ties to effectively implement their strategy. This could be the case for firms pursuing efficiency and exploitation as well as for firms pursuing cutting edge innovation in a limited area of expertise.

H 5: a/b/c/d: Defenders and entrepreneurs will have, on average, stronger ties than prospectors and analyzers.

The proposed relationships between strategic orientation and alliance portfolio configuration are summarized and presented in Figure 8. In addition to significant differences across strategic groups along single network characteristics, I also expect to find "alliance portfolio profiles"

(that is the aggregate of alliance portfolio characteristics) to vary across groups – and to be relatively homogeneous within the individual strategic group.

H 6: Overall, alliance portfolio profiles will differ across strategic types along the above described three dimensions.

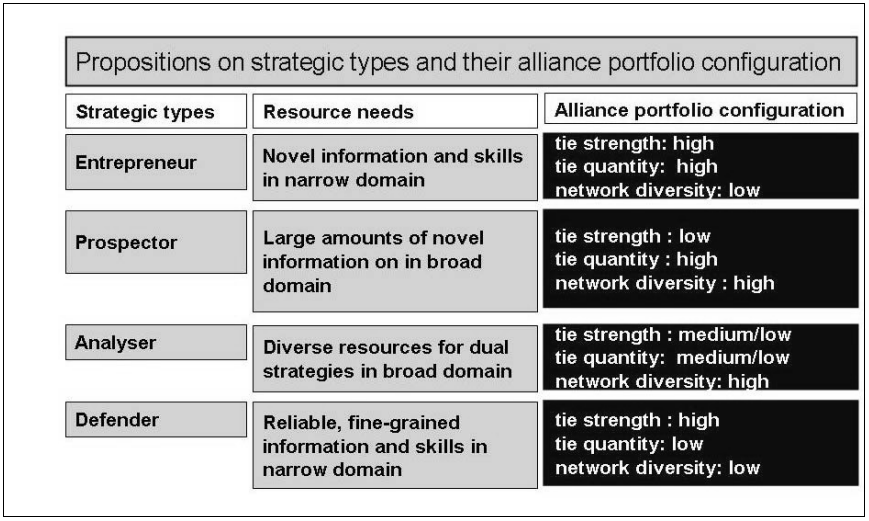

Figure 8: Propositions on strategic types and their alliance portfolio configuration.

4 Empirical Setting: The pharmaceutical industry

The pharmaceutical industry offers an ideal setting for my research for several reasons that will be elaborated on in greater detail in chapter 5.2 when the sample is defined. The following section contains an overview of the pharmaceutical industry as well as a discussion of the peculiarities of the pharmaceutical value chain and the special role of alliances, mergers and acquisitions for value creation in this vibrant business context.

4.1 Overview of the pharmaceutical sector

The modern pharmaceutical industry emerged during the 1920s and 1930s, with the discovery (and mass production) of penicillin and other antibiotics. The industry grew significantly during and after World War II and diversified into new therapeutic areas and vaccines. Today, although growth rates have declined lately, the pharmaceutical industry is one of the fastest growing markets with growth rates in the low teens between 1998 and 2003. In 2004, the industry grew by 8% to roughly $518 billion. In 2005, growth slowed down to 7% and global pharmaceutical sales reached $565.9 billion. In the 12 months ended June 2006, global pharmaceutical sales growth decelerated further to 6.2% and the market was estimated at $582 billion. Overall, the industry today ranks fifth in profitability with sales growing by roughly 6-7%. This is not bad compared to other manufacturing industries, but quite a decline from glories of the 1990s, when the industry enjoyed growth rates in the lower to mid-teens (Saftlas and Diller, 2006: 12).

The drug industry is characterized by high risks and high rewards: out of 5000 compounds discovered, only one ever reaches the customer and hardly a third of marketed drugs earn their own costs (Saftlas and Diller, 2005: 22). On the other hand, big pharmaceuticals like Pfizer, GlaxoSmithKline and Novartis reach between $20 and $50 billion yearly sales (see Figure 9). According to IMS Health, 82 blockbusters with global sales over $1 billion and 33 drugs with sales over $2 billion were marketed in 2004.

„Big Pharma"- Leading pharmaceutical companies' pharmaceutical sales

	COMPANY	GLOBAL SALES (billion $)
1	Pfizer	50.90
2	GlaxoSmithKline	32.70
3	Sanofi-Aventis	27.10
4	Johnson & Johnson	24.6
5	Merck	23.9
6	Novartis	22.7
7	AstraZeneca	21.6
8	Roche	17.7
9	Bristol-Myers Squibb	15.5
10	Wyeth	14.2

	COMPANY	US SALES (billion $)
1	Pfizer	30.70
2	GlaxoSmithKline	18.80
3	Johnson & Johnson	16.20
4	Merck	15.00
5	AstraZeneca	11.30
6	Novartis	10.20
7	Sanofi-Aventis	10.00
8	Amgen	9.50
9	Bristol-Myers Squibb	9.20
10	Wyeth	8.20

Figure 9: „Big Pharma"–global and US sales 2004. Source: Saftlas and Diller (2005: 11).

While demographic trends (aging population in the largest markets, lengthening of average life expectancy and an increase in chronic diseases) are favorable for the industry, the intensifying competition from generics companies and the lack of internal promising projects in discovery and early development constrains the growth opportunities of big prescription pharmaceuticals (Saftlas and Diller, 2006). Increasing R&D spending has not yet led to greater productivity. The longer a product takes to get to the market, the higher development costs and the greater the losses from forgone sales opportunities.

The U.S. market clearly dominates the industry by making up for 45% of the global market ($261.4 billion for the 12 months ended in June 2006). Europe ranks second with roughly $170 billion and Japan accounts for $ 57.7 billion sales during this period.

The pharmaceutical industry is certainly different from the biotechnology business, which has been evolving dynamically during the past decades. The foundations for the biotechnological revolution were laid already in 1953, when James Watson and Francis Crick first discovered and published the DNA structure (Burns, L. R., 2005: 104). The biotechnology sector includes companies primarily involved in the development, manufacturing or marketing of drugs based on

advanced biotechnology research. In contrast to the pharmaceutical industry, biotechnology uses biological systems, living organisms or derivatives to create proteins with therapeutic potential[9]. The industry is still in its infancy, as even the "oldest" biotechnology companies have hardly gone through two development cycles, which last about fifteen years from discovery through commercialization, and is even riskier than the pharmaceutical development cycle. Biotechnology companies can broadly be classified into three distinct business models: i) the product business model, ii) the platform or tool business model and ii) the hybrid business model. The product business model comes closest to the FIPCO (fully integrated pharmaceutical company) model as pursued by large pharmaceuticals. A platform company, in contrast, doesn't push products through the pipeline but instead generates value at the front end of the industry value chain through licensing fees, technology subscriptions and service fees. The hybrid is typically both – or something in between – with a tendency towards the product model and constitutes of both a platform technology and a pipeline of products (Fisken and Rutherford, 2002). Biotechnology companies are, by far, the preferred business partners of big pharmaceutical companies for both alliances and acquisitions (see chapter 4.4).

4.2 Product groups in the pharmaceutical industry

As the industry is rather complex and diversified, it is necessary to explain some key terms and to discuss distinct product groups and business models within the pharmaceutical sector.

Prescription drugs

The term drug as such is a very wide one and includes, besides medicines to treat illnesses, consumer articles like antiperspirants, dandruff shampoos and sunscreen lotions. Prescription drugs (or prescription pharmaceuticals, also referred to as "Rx"[10]), however, are typically drugs targeted at some illness or disease and therefore require the doctor's prescription for purchase (CDER, 2006)[11]. Burns describes a prescription pharmaceutical as "…drug for human consumption, specifically developed to impact a disease, which goes through the regulatory process designed to approve prescription medications for marketing to physicians" (Burns, L. R., 2005: 27). Obviously, this definition excludes over-the-counter drugs, vitamins, nutritional

[9] Please see the Glossary for a definition of biotechnology.
[10] Rx = prescription drug and originates from the abbreviation of "recipe" (latin: to take). Source: www.wikipedia.org
[11] The CDER is the FDA's Center for Drug Evaluation and Research (see the Glossary for a detailed description).

supplements and herbs. The CDER simply states that "prescription medicines must be administered under a doctor's supervision or require a doctor's authorization for purchase" (CDER, 2006: 1). In this research, I will stick to the latter definition. Therefore, my sample (as described in more detail in chapter 5.2.2) will consist of pharmaceutical companies generating at least 70% of their sales from prescription pharmaceuticals (including generics).

Before commercialization, prescription drugs have to be approved by the country's regulatory body (in the U.S. the FDA). New drugs have to undergo a long process of clinical trials and reviews before they are admitted to the market (see the section on discovery and development in chapter 4.3 later on). Only in some cases, that is if the drug is needed ad hoc to treat some life-threatening disease, accelerated approval may be granted (e.g. after successful completion of phase II) (CDER, 2006).

Over-the-counter drugs

Over-the-counter (OTC) drugs can be purchased at any pharmacy or supermarket without a doctor's prescription. Typically, OTC drugs are originally available by prescription only before the CDER approves the "Rx-to-OTC" switch to make the medication more easily available for consumers. The OTC drug review is an ongoing assessment of the safety and effectiveness of prescription drugs as well as nonprescription drugs already on the market and often leads to Rx-to-OTC switches. However, OTC drugs can also be approved under the new drug application (NDA) process, if the manufacturer takes the initiative and submits data proving the safety of the drug (CDER, 2006).

Generic drugs

Generic drugs are chemically identical to their original branded versions, but typically much cheaper and therefore promoted by the public health system as they help to control medical and insurance costs. They are available in both OTC and prescription forms. The main reason that generics can be offered at a much lower price compared to their branded counterparts is that generics manufacturers don't have to repeat expensive clinical trials and save the majority of development costs[12]. Essentially, the process starts when a brand-name manufacturer submits

[12] Under the Drug Price Competition and Patent Restoration Act (1984), also known as Hatch-Waxman Act, manufacturers only have to prove that their generic drugs are bioequivalent to the patented version, instead of repeating expensive trials. This act essentially created the generics industry. Source: CDER (2006).

information on its patents to the FDA. The FDA collects all information on patents held, including expiration dates, and lists them in a report called "Approved Drug Products with Therapeutic Equivalence", or simply "Orange Book". Patent protection gives the innovator company the exclusive right to commercialize the drug for an average of 11 years. After this period, and after FDA approval, a "bioequivalent" generic drug can be brought to the market. "Bioequivalence" means that the drug's active ingredients have the same effects on the human body as the branded version. While an innovator company submit a full NDA (new drug application), a generics manufacturer submits an ANDA (abbreviated new drug application), which involves less trials, less administrative hurdles and finally much lower costs. The more generics companies enter the market at patent expiration, the harder the competition and the lower the prices. Prices might drop to as low as 10-20% of the original brand's price before generics hit the market. By law, the generics company that first comes up with a medication gains exclusive commercialization rights for 6 months, which delays competition at least for a short time (Saftlas and Diller, 2006: 5). Some generics manufacturers also launch "at risk", that is before a patent expires or is invalidated by a court. However, this is only done if chances to win in court are high.

Although there are still some almost pure generics manufacturers on the market (e.g. Barr Pharmaceuticals, Mylan Laboratories, KV Pharmaceuticals), there is a tendency for big pharmaceuticals to also diversify into the generics business to compete more effectively on the market. For example, Novartis was formed 1997 by a mega merger between Sandoz (generics company) and Ciba-Geigy (Swiss pharmaceutical company). Watson Pharmaceuticals expanded its generics business from roughly 50% to 75% between 2003 and 2005[13].

4.3 The pharmaceutical value chain

The "pipeline" represents a drug's development process from discovery to commercialization. Out of all steps in the value chain, pharmaceutical companies typically focus on R&D and marketing activities. However, also manufacturing competency is critical to overall returns. First, I will present the "pipeline" from discovery to FDA approval including all milestones set by the regulatory bodies. Then, I will briefly discuss manufacturing and commercialization activities in the pharmaceutical industry.

[13] Source: Compustat U.S. Segments Database

Managing the pipeline – from discovery to product launch

The pharmaceutical business is characterized by high risk, long development cycles and high return rates required to recoup large investments. The typical time span for a drug from concept to commercialization is about 12 years, with development times between 10 and 17 years depending on the specific drug (Burns, L. R., 2005: 34). In addition, success rates are relatively low with a probability of approximately 2% that a project ever makes it to the market (see Figure 10). Probability or success is the main value driver in the pharmaceutical business model and increases as the potential product moves down the value chain. Unlike other industries, the pharmaceutical value chain is dominated by legal frameworks and regulatory requirements as any drug has to go through various phases of preclinical and clinical tests before it is approved for commercialization.

The value chain can roughly be classified into the three phase: discovery, development and commercialization.

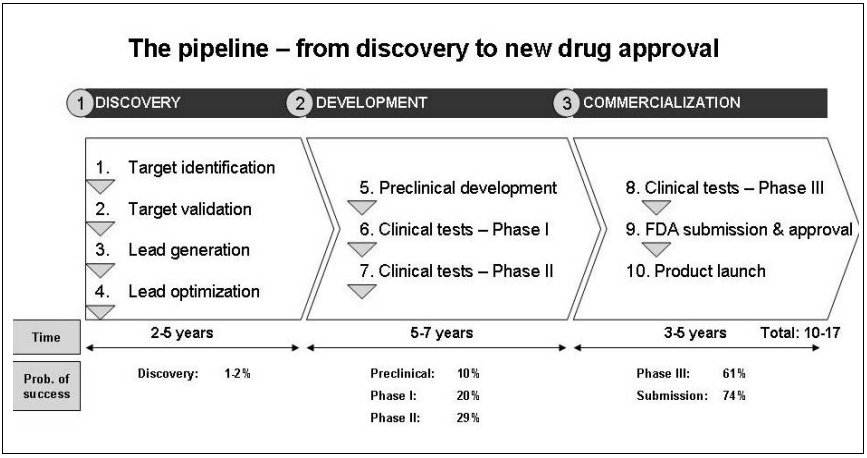

Figure 10: The pipeline. Source: adapted from Burns, L. R. (2005: 54+61).

Discovery starts with identifying a target (a gene, protein or receptor) that is assumed to have a therapeutic effect on a human disease. Second, the target has to be validated to make sure that a manipulation of the target (either blocking or triggering it) will actually have the desired effect on the disease. Lead generation (similar to prototyping in engineering) is the process that aims at

creating a molecule that should ultimately become the drug. Finally, the lead has to be optimized, that is the compound found has to be modified in a way that it can easily be absorbed by a living being and stays long enough in the body to actually reach its target. In the end, a few compounds are selected as candidates for the first preclinical trials (Burns, L. R., 2005: 26; Saftlas and Diller, 2006). Patent application can be done at any time throughout the discovery process (and also later on during drug development).

Preclinical testing is essentially animal testing, which aims at finding out if the compound is worth of testing it on humans. The results of preclinical tests are submitted to the FDA for IND (investigational new drug) approval, which is a necessary prerequisite for starting clinical (= in humans) testing. Subsequently, in phase I studies, small amounts of the drug are administered to healthy volunteers to check on the basic activity of the drug in the human body (e.g. how long does it stay in the body, are there any side effects, does it reach the target, etc.). Only after this phase, the drug is placed in diseased volunteers to see if it shows the desired therapeutic effects. A successful completion of phase II trials increases success rates from roughly 30 to 60% and is arguable the most significant step in the development process. Success rate is the major value driver in the industry and strongly impacts the deal value in alliance agreements and acquisitions (Burns, L. R., 2005: 62; CDER, 2006).

Phase III is really more the first phase of commercialization than the final step in development. In this phase, a large number of patients (often in multiple countries) are tested to achieve statistical significance. Moreover, both physicians and end consumers are already involved in the process and become a target of marketing and commercialization activities. Finally, all results from clinical trials are written up and submitted to the regulatory bodies in a so-called NDA (new drug application). In the U.S., the FDA is obliged to accept or reject an NDA submission within 90 days. After accepting a submission, the FDA studies the submission for six to twelve months, depending on the therapeutic need and priority assigned to the drug. At the end of this period, an advisory board consisting of scientists in the target areas will vote for or against approval, and the FDA's position is usually in line with the committee's vote. Apart from "approved" and "not approvable", there is also the option of sending an "approvable" letter, which means that the FDA wishes to see further amendments and revisions. If the latter is the case, it might take another two to five months to get approval. After the product has been launched, the innovator company typically continues with phase IV studies, which look at questions of efficiency and

economic benefits and go beyond the regulatory requirements (Burns, L. R., 2005; CDER, 2006; Saftlas and Diller, 2006: 26-27).

A patent usually protects a drug for 20 years, however, during more than half of this period, the compound is still in the development phase. Essentially this means that patents expire already 8-10 years after commercialization of the drug starts.

Manufacturing and supply

While R&D productivity stands for sustainable long-term growth and sales and marketing capabilities ensure high short-term returns for shareholders, manufacturing capabilities and efficiency are less often mentioned as important value drivers for large pharmaceuticals. A closer look at financial reports[14], however, reveals that manufacturing costs may easily make up a third of total costs and usually exceed R&D costs. No matter if manufacturing is done internally or carried out by alliance partners, we have reason to believe that there is still a lot of potential to optimize manufacturing activities.

Manufacturing can broadly be classified into two phases, i) bulk manufacturing and ii) "form, fill, finishing" (Burns, L. R., 2005: 74). Efficiency gains in bulk manufacturing of the API (active pharmaceutical ingredient) can be earned through large scales, optimal asset utilization and minimization of all health and environmental negative effects. Form/fill/finishing is often carried out at different sites and involves adding non – chemical substances like starch and lactose to the chemicals (API) in order to form pills, which are consequently packaged in various sizes and shapes. F/F/F sites are usually not outsourced, as these facilities are responsible for the final product. Finally, drugs are either supplied directly to the hospital (e.g. infusions) or will go through wholesalers and pharmacies to the final consumer (retail drugs such as tablets).

Commercialization

Pre-launch marketing activities start as early as at the end of phase II clinical trials. In phase III, broad communication to physicians and patients starts, primarily through the pharmaceuticals' internal huge sales organizations. In 2000, the number of sales representatives in the U.S. alone

[14] 10-k reports of U.S.–listed pharmaceuticals typically publish "cost of goods sold", which roughly represents manufacturing costs.

reached 75,000 people, which roughly equals the number of physicians in the U.S. (Burns, L. R., 2005: 85).

While most products are only moderately profitable, a few compounds have the potential to become “blockbusters”. A blockbuster is defined as a drug that sells more than $1billion a year. The existence of blockbusters in a pharmaceutical company is highly correlated with its overall performance and returns to shareholders. Although blockbusters involve huge marketing budgets ($1-1.5 billion for one year of pre-launch and two years of post-launch activities), they are highly profitable over their life cycle as the innovator company can easily recoup high R&D and marketing expenses. Most drugs, however, never become a blockbuster due to problems that occur during discovery and development. For example, side effects are found or only a share of the target population responds to the medication (Burns, L. R., 2005: 81).

4.4 Pipeline management, risk and the role of alliances and M&A

According to Burns (2005: 89), keeping a “smooth-flowing” pipeline is hard for the following reasons. First, the risk of drug fallout persists all way along the value chain. Second, the later a drug fails, the harder it is for the company to compensate for its loss. Third, even high success rates may cause harm: high investments in late-stage development withdraw funds from early-stage projects, a process that also has negative effects on continuous new product development. In other words, high fluctuation in innovation output causes high costs and inefficiencies – and unfortunately these fluctuations are rather the rule than the exemption. Moreover, different kinds of products involve different levels of risk. Consequently, pharmaceuticals have to balance their product portfolio as a mix of “create-a-market” products (high risks, high returns) and “me-too products” or “improved profile” products, which are not new but simply show improved characteristics compared to their already existing counterparts (Burns, L. R., 2005). Alliances and acquisitions are an essential means to fill up the pipeline at any stage whenever necessary and thus help to even out fluctuations in new product applications. Among the most popular deals are in-licensing agreements where a big pharmaceutical gets access to an early stage promising compound discovered by a biotechnology company or even a small, innovation-focused pharmaceutical. Deals may also occur between two larger pharmaceutical firms to better realize the full market potential of a molecule or drug. Even the most promising discoveries and pharmaceutical projects have a short life time and may become worthless if not used immediately. For example, a company that lacks internal resources and is therefore not able to

develop some promising product internally, is better off out-licensing the product to a partner (even a competitor) than not using its value at all.

4.5 Summary

The pharmaceutical industry is characterized by high development cycles, high risk, but also high returns in the case of success. The dearth of internally developed products as well as heavy price competition caused by generics entering the market after patent expiration represent major challenges for the industry. As already discussed in the theoretical part of this research, alliances play an essential role for a firm's resource management (see chapters 1.2.2.4 and 3.3). The pharmaceutical industry is an excellent example for the central role alliances can take in an industry. Alliances are used at any point along the value chain to even out fluctuations in resource supply and demand. More specifically, companies may engage in in-licensing to compensate for a lack of internal research projects (e.g. obtaining rights to a promising compound at discovery stage from a biotechnology company) or even outpartnering (e.g. granting marketing rights for internally developed products to another pharmaceutical company if the drug's potential cannot be fully used otherwise). In a nutshell, alliances are built with diverse partners and at different product development stages to either get access to external resources, give access to own resources, or even both (e.g. in a joint development R&D project).

5 Methods

A sound empirical analysis calls for a considerate selection of the appropriate sample, variables and statistical procedures to be applied. In this section, I will first give an overview of the overall research design. Next, I will discuss the sample, the data and the various data sources employed. Finally, I will explain my choice of variables to measure both business strategy and alliance portfolio configuration.

5.1 Research design overview

The aim of this research is to analyze the relationship between a firm's strategic orientation and the characteristics of its alliance portfolio. The underlying assumption here is that a "fit" between strategy and alliance portfolio configuration should ceteris paribus lead to better performance.

Several quantitative empirical studies in strategic management research have dealt with the relationship between business strategy and some other organizational feature, e.g. pay system design (Boyd, B. and Salamin, 2001; Yanadori and Marler, 2006), top management characteristics (Thomas, A. S., et al., 1991) or top management compensation (Veliyath, et al., 1994). Veliyath et al. (1994) compare employment risk, top management compensation and firm performance across prospector, defender and analyser strategic types (Miles and Snow, 1978) and found substantial differences. They study 46 publicly traded U.S. pharmaceutical companies, collecting accounting data from annual reports for strategic classification over a four-year period (1985-1988) to even out short-term fluctuations. First, clusters are derived using Ward's minimum variance method (Fiegenbaum and Thomas, 1990) and second, the means of the dependent variables are compared among strategic types employing ANOVAs[15]. Boyd and Salamin's (2001) study is situated among Swiss financial institutions and studies the link between business strategy and pay systems. Miles and Snow's (1978) strategic types are seen as a continuum of strategic orientation towards change, with prospectors representing the upper end, that is strong orientation towards change, and defenders representing the opposite end. The authors use a combination of investigator assessment, expert interviews and archival data to classify business units of financial institutions into strategic groups (1, 2 and 3 for

[15] ANOVA= Analysis of Variance. See chapters 7.1 and 7.2 for a more detailed description.

defender, analyser and prospector, respectively). Hierarchical regression analysis was used to test the relationship between "orientation towards change" on a scale from 1 to 3 and several pay system components: base pay, bonus and leverage were used as dependent variables in separate models. Thomas et al. (1991) study the fit between top executive characteristics and the company's strategic orientation - and particularly the impact of this coalignment on performance. The authors employ Miles and Snow's (1978) typology to identify strategic types based on archival data from annual reports and 10-k statements. Consequently, a series of directional t-tests is performed to compare CEO profiles across the two extreme strategic types, defenders and prospectors. Proposed linkages in the model are supported by the empirical tests.

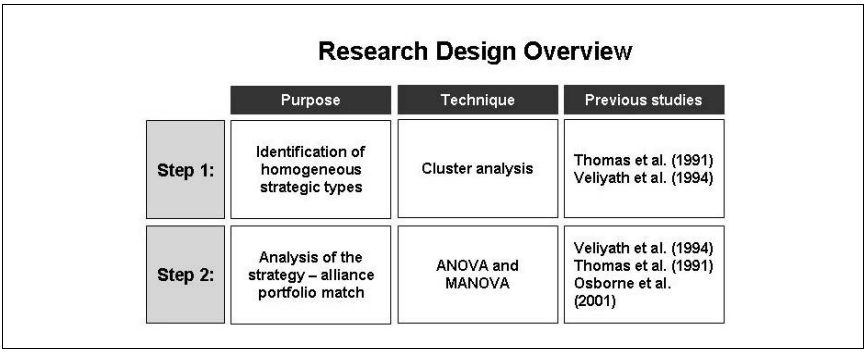

Figure 11: Research Design - Overview

In this study, I will employ a research design similar to Veliyath et al. (1994) and Thomas et al. (1991). First, I will use cluster analysis to group sample companies into strategic groups. Second, I will compare alliance portfolio characteristics (network size, network diversity and tie strength) across strategic groups. Univariate and multivariate techniques will be employed to compare individual network characteristics and network profiles consisting of several network measures, respectively (see Figure 11).

Measuring business strategy

Strategic typologies, particularly the Miles and Snow (1978) framework, have been operationalized by strategy scholars in many different ways. Conant et al. (1990: 369-370) give an excellent overview of previous measurement approaches. **Self-typing** refers to a procedure where respondents, typically top managers, are asked to classify their company as one of the

strategic types based on paragraph descriptions (Segev, 1987b; Snow and Hrebiniak, 1980). Other forms of self-typing involve multi-item Likert-type scales in questionnaires administered to members of the management team (Segev, 1987a). Another approach is the use of **objective indicators** (e.g. the percentage of sales derived from new products), which is useful with larger samples and easier to interpret (Hambrick, 1983; Segev, 1989). Some scholars have also relied on **external assessment** (e.g. an expert panel) or used **investigator inference** based on interviews with managers to classify companies (Meyer, 1982; Ruekert and Walker, 1987). Moreover, **combinations** of the above mentioned approaches have commonly been employed by scholars, e.g. objective indicators combined with expert interviews and investigator inference (Hambrick, 1982; Shortell and Zajac, 1990). Another interesting, increasingly popular alternative is the use of computer-assisted **content analysis** of annual reports, 10-k statements or presidents' letters to shareholders to classify companies into distinct strategic groups (Krippendorf, 2004; Osborne, Stubbart and Ramaprasad, 2001; Weber, R. Ph., 1988).

As already described in chapter 3.4, I will draw on Miles and Snow's strategic typology in combination with Zammuto's framework as theoretical basis for deriving homogenous strategic groups. Initially, I experimented with basic software-assisted content analysis and generated simple key word lists and KWIC[16] lists. I used standardized paragraphs of 10-k reports of publicly listed pharmaceutical companies to come up with key word lists, however without any meaningful results. A classification of companies into strategic groups based on the frequency of certain words or phrases in key strategic documents turned out to be quite equivocal. After a careful review of previous operationalizations and how they would apply to my sample of pharmaceutical companies, I decided to use objective indicators from archival databases and financial reports for classification. Accounting data and other secondary data on the companies' scope of activities and innovation performance is relatively well available for the past couple of years and can be employed in cluster analysis. I used archival data for both measuring strategy and alliance portfolio characteristics (see chapter 5.5 for a more detailed description on variables employed in this study).

[16] KWIC is an acronym for Key Word in Context, the most common format for concordance lines. Source: wikipedia.org

Comparing alliance portfolios among strategic types

The only way to get hold of multiple years of alliance data of all sample firms is to use archival data based on press releases. Companies like Pfizer manage over 250 alliances, which can hardly be captured and analysed by using interviews or surveys. For comparing individual alliance portfolio characteristics among strategic groups, I used comparisons of mean values, that is ANOVAs and potentially MANOVA[17] to compare not only individual dependent variables but the entire set of dependent variables (alliance portfolio profile) among strategic types.

5.2 Sample

I have chosen the pharmaceutical industry as setting for my empirical study for the following reasons. First, it's a highly dynamic, innovation-driven and alliance-intensive industry. The key to success is a "smooth-flowing" pipeline, which means keeping up a steady stream of product innovations that make it to the market. As innovation is risky and projects tend to fail even in later stages of development, companies have to complement internal with external resources by entering into strategic alliances and/or getting involved in mergers and acquisitions (Burns, L. R., 2005: 89). Second, alliance portfolio data can be operationalized relatively well as the individual phases in the pharmaceutical value chain are standardized due to FDA[18] requirements. Alliance deals typically cover one or more of these phases. Third, industry players have come up with diverse strategies to face the challenging environment. "First-to-market" strategies with a wide product portfolio (e.g. Pfizer) may be as successful as focused strategies (e.g. Alcon focusing on Eyecare) or defensive strategies (e.g. King Pharmaceuticals focusing on the efficient commercialization of generics and other pharmaceuticals). Put differently, some companies follow innovation strategies while others focus on imitation and/or efficiency (Cool and Schendel, 1987; Lee, J., 2003). Strategic diversity is important for classifying the companies into "strategic types". Fourth, the industry has just the right degree of consolidation, that is pharmaceuticals are large international companies, but consolidation has been moderate enough to leave a reasonable amount of independent companies in the market (in contrast to, for example, the small number of OEMs in the automotive industry). The top 50 pharmaceutical companies earned between $52 billion and $1.5 billion of sales in 2004. Finally, due to the size

[17] MANOVA = Multiple Analysis of Variance. See chapters 7.1 and 7.2 for further details on the method.
[18] FDA= Food and Drug Administration, manages drug approval process in the US (see Glossary for a detailed description).

of the businesses, their public listings and the generally high reputation of the industry amongst investors, a fair amount of business data is publicly available[19].

5.2.1 Defining industry borders

Prior to data collection, the sample had to be defined carefully to fit the specific requirements that come along with the particular research questions and hypotheses. As we have seen in chapter 4, the pharmaceutical industry is a complex and diverse research setting and its borders are not clearly defined in the literature or even in industry reports. While Burns (2005: 27) narrowly defines pharmaceuticals as prescription drugs for human consumption, Datamonitor[20] includes both ethical (=branded prescription) drugs and OTC (over-the-counter) drugs in their analysis, excluding only consumer healthcare[21] and animal healthcare from their market definition.

GICS (Global Industry Classification Standard), NAICS (North American Industry Classification System) and SIC (Standard Industrial Classification) are widely accepted, exhaustive coding systems. All publicly listed companies carry GICS, SIC and NAICS codes and can therefore be linked to a specific industry. While SIC and NAICS codes match almost perfectly, the GICS logic is somewhat different (see Table 2, Table 3 and Table 4)[22].

NAICS (North American Industry Classification System)
Breakdown of 3254: Pharmaceutical & Medicine Manufacturing

325412	**Pharmaceutical preparation manufacturing**
325413	In-vitro diagnostic substance manufacturing
325414	Biological product (except diagnostic) manufacturing

Table 2: The Pharmaceutical Industry within the NAICS Coding Scheme.

[19] Data sources are described in chapter 5.4.
[20] Source: Datamonitor Industry Market Research, 2005 (information service for general and financial industry data).
[21] Consumer healthcare is a general term that refers to any product supporting the consumers' health, e.g. toothpaste, nutritional supplements, feminine hygiene, etc.
[22] For a full list of SIC codes see e.g. http://www.sec.gov/info/edgar/siccodes.htm.

SIC (Standard Industrial Classification):
Breakdown of 2800 – Chemicals & Allied Products

2833	Medical chemicals, botanical products
2834	**Pharmaceutical preparations**
2835	In vitro, in vivo diagnostics
2836	Biological Products (No diagnostic substances)
2800	Chemicals and Allied Products

Table 3: The Pharmaceutical Industry within the SIC Coding Scheme.

SIC and NAICS coding systems are based on the traditional distinction between production, trade and services. GICS is based on more recent industry definitions and does not strictly follow the manufacture – wholesale - service structure. It is a widely accepted industry classification framework developed by Morgan Stanley Capital International (MSCI) and Standard and Poor's (S&P). The GICS structure consists of 10 sectors, 24 industry groups, 62 industries and 132 sub-industries.

GICS (Global Industry Classification Standard) - S&P Market Insight
Break-down of the Health care industry (3510 and 3520)

35201010	Biotechnology: Companies primarily involved in the development, manufacturing or marketing of products based on advanced biotechnology research
35202010	**Pharmaceuticals: companies engaged in research, development or production of pharmaceuticals. Includes veterinary drugs.**
35101010	Health Care Equipment: Manufacturers of health care equipment and devices. Includes medical electronic precision instruments. Includes drug delivery systems.
35101020	Health Care Supplies: Manufacturers of health care supplies and medical products not classified elsewhere. Includes eye care products.
35102010	Health Care Distributors: Distributors of health care products not classified elsewhere.
35102015	Health Care Services: Providers of health care services not classified elsewhere. Includes dialysis centers and lab testing services.
35102020	Health Care Facilities: Owners and operators of health care facilities, including hospitals, nursing homes, rehabilitation and retirement centers and animal hospitals
35102030	Managed Health Care: Owners and operators of Health Maintenance Organizations (HMOs) and other managed plans.

Table 4: The Pharmaceutical Industry within the GICS Coding Scheme.

Obviously, generics companies are included in the pharmaceutical industry according to the above described coding systems. Although the generics business is without any doubt different to the branded drug business (Burns, L. R., 2005: 33), it makes sense to include generics manufacturers in the sample for two major reasons: First, generics and branded drug companies are in direct competition to each other and compete for customers and market share. Second, borders between pure generics manufacturers and pharmaceutical companies have started to blur as big pharmaceuticals start their own generics business (e.g. Novartis) and generics manufacturers diversify into other businesses.

I also discussed this issue with industry experts[23] who largely reconfirmed my approach to industry definition, particularly in the light of my research questions which involve a strategic classification of sample companies. It makes sense to see the generics business as one possible "strategic approach" to succeed on the market for pharmaceutical preparations to fight diseases. Previous studies that involved discussions with executives report similar findings, i.e. that generics represent a difference in competitive posture that seems to represent precisely the intraindustry differences that the analysis is all about (Bogner, Thomas and McGee, 1996).

Biotechnology is certainly a different business - with the exemption of large, fully integrated biotechnology companies. According to the GICS industry definition, it includes companies primarily involved in the development, manufacturing or marketing of products based on advanced biotechnology research[24]. Business models of biotechnology companies have developed rapidly and some biotechnology start-ups have eventually succeeded to adopt the FIPCO (fully integrated pharmaceutical company) business model, with Genentech and Amgen being the most prominent examples[25] (Fisken and Rutherford, 2002: 192). Fisken and Rutherford (2002) discuss three different business models within the biotechnology industry, that is the platform business model, the hybrid business model, and the product business model. The latter tends towards the FIPCO model, which means that it aims to generate value by progressing products along the pipeline and either licensing them out to pharmaceuticals and top tier biotech companies or, if there is enough free cash flow, taking them directly to the market. For a start, I

[23] I interviewed industry experts and managers at The Wharton School, University of Pennsylvania, during the Wharton/Windhover Program for Pharmaceutical & Biotech Executives. For interview summaries see Appendix 1. Particularly, I want to thank Gary Kaplanovich, Director of Finance, Strategic Business Analysis (Sanofi Aventis) for sharing his industry knowledge and expertise and giving insightful feedback on my work.
[24] For a definition of biotechnology see the Glossary.
[25] Fortune 500 ranks Genentech 11th in "*pharmaceuticals*" – with sales reaching $ 12,430 million in 2004.

decided to include large biotechnology companies (yearly sales over $ 1 billion) that have fully adopted the FIPCO model and thus directly compete with other pharmaceutical companies.

5.2.2 Defining the sample

I decided to limit my sample to U.S. – listed companies to guarantee high levels of data availability and quality and to control for differences across countries, e.g. due to different accounting standards (Bierly and Chakrabarti, 1996; Cool and Schendel, 1987; Veliyath, et al., 1994). Privately held companies unfortunately publish only a small part of the data required. In contrast to previous studies in the field, which focused on the largest pharmaceutical companies (Bogner, et al., 1996; Cool and Schendel, 1987; Rothaermel, 2001; Yeoh and Kendall, 1999), I aimed at including also smaller companies (down to $10 million annual sales) to capture the broadest possible spectrum of competition.

Taking the above discussed issues into consideration, I followed a stringent procedure to arrive at my final sample: First, I put together a list of all pharmaceutical companies (SIC 2834 or GICS Pharma) and all biotechnology companies (SIC 2836 or GICS biotech)[26], the latter only if 2004 sales reached $100 million or more. I used the Compustat US database to identify companies based on SIC codes and S&P Market Insight to retrieve lists of all industry constituents based on the GICS system. It is common practice among scholars in the field to use SIC codes for sample definition, although many authors have used multiple sources to cross-reference and complement their data (Rothaermel, 2001: 692). I excluded non-listed companies due to data availability problems and thus started with a sample of 285 US listed companies. After elimination of entities that had been acquired, the number dropped to 276.

Next, I eliminated companies that earned less than $10 million to avoid data availability problems and exceptionally small and young companies that do not (yet) have an established strategy. Those firms were typically classified as biotech by either the SIC or the GICS coding system or both. In addition, I eliminated all companies that were obviously not in the pharmaceutical business. Especially the SIC 2834 classification is very broad and includes speciality chemicals and personal products that target consumer needs very different to those of

[26] I retrieved all pharmaceutical (biotechnology) companies coded as 2834 (2836) within the SIC system or 35202010 (35201010) within the GICS system. Although a great portion of codes matched, some firms were coded as pharmaceutical (biotech) only in one of the two classification schemes. To be eligible for this initial list, companies needed to be coded as pharmaceutical (biotech) by at least one classification scheme.

pharmaceutical products. While my original sample included all SIC 2834 companies, it was necessary to eliminate those companies that did not primarily develop, produce or distribute pharmaceutical products (e.g. GICS Personal Products and GICS Health Care Services, distributors), even if they classified as SIC 2834. Large diversified companies like Bayer, Baxter and Procter & Gamble didn't make it into the sample in the first place. Companies classified as "biotech" by both classification systems only stayed in the sample if their 2004 annual sales reached $1 billion (Amgen Inc., Serono SA, Biogen Idec Inc., Genzyme Corp., Gilead Sciences Inc., Medimmune Inc. and Invitrogen Corp). By then, sample size had shrunk to 125 companies.

In order to be eligible for subsequent statistical analyses, remaining companies were narrowed down further to include only those that were primarily engaged in the prescription pharmaceutical business. Therefore, I checked all of the remaining companies individually

First, I checked websites and annual report of the remaining firms to make sure that they were primarily engaged in the prescription drug business.

Second, I downloaded relevant accounting and business data from the Compustat Segments database for the sample companies for a 3-year period from 2003-2005. For each year, I calculated the share of pharmaceutical sales in total sales and averaged numbers over the 3-year period. I compared results from this quantitative analysis with the above described qualitative checks to enhance the overall quality of the process. I excluded all companies earning less than 70% of their sales in the prescription pharmaceutical business (rule of "dominant business", see chapter 5.3).

Third, I explored the strategic continuity of the sample firms by checking accounting data over the past three years for outliers. More specifically, I checked changes in sales and assets levels to understand major strategic shifts (mergers, acquisitions and sales) of the firms[27]. Generally, companies had consistent strategies over that period. However, some had to be eliminated because they changed business too radically within the past few years. For example, Able Laboratories stopped business in 2005 due to chapter 11 in-progress and were bought by Sun Pharmaceutical Industries.

[27] Compustat offers - besides the traditional year data – also „restated" data, which allows analysts to compare current years with prior years that have been restated (i.e. adapted) for M&As, accounting changes or discontinued operations. Companies can report restated data for up to 10 years back. Source: Compustat North Amerika User's Guide - Chapter 2).

Some examples of companies that dropped out at this point include Draxis (less that 70% pharmaceutical sales), Interpharm (belongs to Atec since 2003), Hospira (primarily a medical equipment manufacturer) and Alpharma (generics business sold to Atec in 2005 and the remaining business focuses on animal health). As the only exemption, although pharmaceutical sales only reached 46%, Johnson & Johnson was kept in the sample as strategic variables were consistent with other similar players (e.g. GlaxoSmithKline, Eli Lilly, etc.).

Finally, I was left with a sample consisting of 98 companies, consisting of 91 pharmaceutical companies with a minimum of $ 10 million annual sales and 7 biotechnology companies already listed above with a minimum of $ 1 billion annual sales. Sample companies derive at least 70% of their sales from pharmaceuticals, including generics, but excluding animal health, consumer health and over-the-counter drugs.

5.3 Data

During research design and data collection I faced several challenges related to choosing the adequate level of analysis and time periods. While I could draw from previous studies that used a strategic typology to classify their sample into distinct strategic groups, none of those studies related strategy to alliance portfolio configuration. Strategy scholars typically average strategic data over a 3-5 year period to capture the fairly stable main strategic orientation of a firm. On the other hand, network researchers typically relate alliance networks to some performance measure, whereby alliance data is collected over a certain period of time and performance data is lagged 1-3 years depending on the subject matter.

Level of analysis – corporate versus business unit level

One of the main issues I faced during sample selection and data collection was the difference between corporate and business unit level of analysis. While strategic typologies are theoretically targeted at the business level, the required data is only available at the corporate level. Some pharmaceutical companies derive the majority of their revenues from the pharmaceutical core business (prescription drugs), others operate in several businesses including prescription drugs, consumer heath care (OTC), vaccines and animal health care. Large diversified companies such as Baxter also engage in medical devices and other chemicals.

In line with previous studies (Bierly and Chakrabarti, 1996; Cool and Schendel, 1987; Rumelt, 1974; Thomas, A. S., et al., 1991; Veliyath, et al., 1994) and to cope with the above described challenge I limited my sample to companies earning at least 70% of total sales ("dominant industry", Rumelt, 1974) in the pharmaceutical industry. This focus helps to establish comparability across organizations and allows the researcher to take corporate level data (e.g. sales, assets, employees) to represent pharmaceutical business unit level data for all subsequent analyses (Cool and Schendel, 1987; Thomas, A. S., et al., 1991). I didn't find a single study in this field that retrieved business unit level data. For those reasons, I did not distinguish between business strategy and corporate strategy in this study. However, I made sure to relate *pharmaceutical* alliances to the *pharmaceutical* business of the companies, irrespective of the organizational position of the pharmaceutical business. Alliance data were only collected for pharmaceutical (Rx) deals. Key strategic variables for cluster analysis were selected to refer primarily to the pharmaceutical business (e.g. R&D measures, NDAs, NMEs and therapeutic areas).

Level of analysis – the alliance portfolio

My unit of analysis is the individual organization and its portfolio of alliances. All alliance data were aggregated at firm level, that is instead of discussing each alliance separately the analysis focuses on the "mix" of partners and alliances employing heterogeneity indices. Alliance characteristics were averaged over all alliances of a given firm.

Time issues

Strategic firm-level variables were collected and averaged over a three-year period (2003-2005) to even out smaller short-term fluctuations (Bierly and Chakrabarti, 1996). Strategic orientation is assumed to be relatively stable in the literature (see chapter 2). Radical shifts are only (if at all) expected in cases of change of ownership (e.g. merger or acquisition) or drastic environmental changes; I considered both possibilities when checking the sample data (see chapter 5.2.2).

Alliance data (Rx deals only) were collected over an 8-year period from 1998 to 2005. While a marketing alliance can have short-term effects on firm resources and output measures, R&D alliances might take longer to show any results due to the long development cycles in the industry. As the study includes all types of alliances, a sufficiently long period of time had to be

chosen to capture all relevant alliance decisions that are related to firm strategy and have some effect on the firm's resource position and ultimately performance. Terminated alliances were excluded from the analysis to ensure that the accumulated alliance portfolio (=the sum of all existing alliances) accurately represents the firm's current strategic intent. This approach is in line with existing studies that operationalize a firm's alliance network and relate it to some other construct. Reuer and Ragozzino (2006) relate corporate board composition to alliance decisions and collect alliance data over a 5 year period after measuring inside ownership (board composition) as stock variable. Ahuja (2000a) collects alliance data as well as patent data over a 10-year period, allowing for a 1-year time lag between collaboration and innovation output.

For purposes of practicability and data availability, I decided to do a cross-sectional study. A longitudinal study would have required the collection of alliance and strategy data further back in time, which was not possible due to limited data access and time constraints.

5.4 Data sources

The research design of this study requires huge amounts of data on both the companies themselves and their entire set of alliances.

Alliance data was primarily retrieved from the Windhover SIS (Strategic Intelligence Systems) database. I collected data on Rx (prescription drugs) deals, including strategic alliances, product acquisitions and (partial and full) acquisitions. Windhover data is sourced from a multitude of primary and secondary sources like industry journals and newsletters, company press releases, and Securities and Exchange Commission contract filings. The strategic transactions database includes deals from 1991 to present and is updated weekly by Windhover's research analysts. Windhover specializes in health care industry research and – apart from offering data services to pharmaceutical companies – also publishes In Vivo and Start-up, two relevant industry journals. The Windhover SIS is an online database with restricted access for subscribers[28].

Additionally, I used the SDC Platinum database, a Thomson Financial database providing comprehensive time series data on mergers and acquisitions including joint ventures and strategic alliances. I accessed the database from the Lippincott Library, The Wharton School, University

[28] I gratefully acknowledge the support of Ian MacMillan to get me in contact with industry experts, managers and particularly Roger Longman, Managing Partner at Windhover Information Inc., who granted me access to the Windhover SIS. I would like to

of Pennsylvania. I also used information from ReCap (biotechnology industry information and analysis; alliance data and description of clinical trials) and Factiva, where I cross-checked individual alliance announcements when data was missing in my primary sources.

Accounting data was obtained from Standard & Poor's COMPUSTAT North America database, specifically the "Industrial Annual" and the "Segments" datasets. Additionally, I collected data from annual reports and 10-K forms.

Data on the therapeutic scope of sample companies was retrieved from the Windhover SIS database and complemented where necessary by checking companies' websites and annual reports.

New drug applications (NDAs), New molecular entity drugs (NMEs), Biologics (BLAs) and New Biologics were collected from the FDA - CDER[29] websites (http://www.fda.gov/cder/rdmt/ and http://www.accessdata.fda.gov/scripts/cder/drugsatfda/) and the FDA Orange book (http://www.accessdata.fda.gov/scripts/cder/drugsatfda/).

5.5 Variables

After a thorough theoretical discussion of the concept of strategy (see chapters 2 and 3.4) and the alliance portfolio construct (see chapter 3.5), measures will be discussed in the following section.

5.5.1 Measuring strategy

Different approaches to classifying companies into strategic types have already been discussed in chapter 5.1 and include self-typing, investigator inference, Likert-scale based surveys, objective indicators as well as combinations of the above. This research uses objective indicators (accounting and business data) to measure strategy and to cluster companies into distinct strategic groups. In line with previous strategic management literature (Ansoff, 1965; Cool and Schendel, 1987; Day, 1984; Hofer and Schendel, 1978), I argue that business strategy involves minimally two sets of managerial activities: i) those dealing with business scope - that is market segments targeted, types of products offered in those segments and geographic reach - and ii)

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express my appreciation and thanks to Roger Longman and his team for their support.

[29] FDA = U.S. Food and Drug Administration; CDER = FDA's Center for Drug Evaluation and Research.

those dealing with resource commitments - that is the relative focus on specific organizational functions, e.g. R&D and marketing versus production (Cool and Schendel, 1987: 1106). Zammuto's (1988: 110) framework of strategic types (see chapter 3.4.5) builds on similar dimensions, that is i) breadth of domain and ii) basis of competition (efficiency versus pursuit of new opportunities). Miles and Snow's (1978) strategic types are usually lined up against a continuum of "orientation towards change" (Boyd, B. and Salamin, 2001), which is essentially measured by the same variables as Zammuto's "efficiency versus new opportunities" dimension. The second dimension, that is the breadth of domain, is also essential to Miles and Snow's framework (defenders service a stable market niche while prospectors constantly expand their product/market base). A summary of previous operationalizations of these major dimensions of business strategy in empirical studies is shown in Table 5 and Table 6.

The variables and their measurements in this research were determined through a two-stage process. First, the existing empirical literature employing objective indicators and cluster analysis to classify companies into strategic groups was screened for potential measures of strategy as well as performance indicators (see Table 5 to Table 8). Second, out of this "long-list", strategic variables were selected that i) were rather product/market oriented, ii) potentially available and iii) where defender and prospector companies would score on the exact opposite of scales.

Previous operationalizations of business strategy (objective indicators)

Dimension 1: Breadth of domain (breadth vs. focus in market segments targeted, products offered, geographic reach)				
Author	**Framework/Construct**	**Measures**	**Data Source**	**Industry**
Shortell/Zajac (1990)	breadth of domain	no of diversified services offered	American Hospital Association	health care (hospitals)
Veliyath et al (1994),	breadth of domain	no of product lines		pharmaceutical
Cool/Schendel (1987)	breadth of scope (focus of activities)	% Rx sales in total sales	IMS, Paul de Haen New Drug Analysis and New Product Survey FDA, annual reports, 10-k reports	pharmaceutical
Cool/Schendel (1987)	breadth of scope (focus of activities)	% generic sales in total sales	IMS, Paul de Haen New Drug Analysis and New Product Survey FDA, annual reports, 10-k reports	pharmaceutical
Cool/Schendel (1987)	breadth of scope (focus of activities)	Rx sales in 3 largest therapeutic areas	IMS, Paul de Haen New Drug Analysis and New Product Survey FDA, annual reports, 10-k reports	pharmaceutical
Thomas/Litschert/ Ramaswamy (1991)	breadth of domain	no of product lines	annual reports, 10-k forms	electronic computing equipment
Bogner et al (1996)	breadth of domain	Index measuring concentration of drugs by therapeutic classes (over the past x years), Herfindahl-type index	Script magazine, IMS, Physicians Desk Defence	pharmaceutical
Yeoh/Roth (1999)	breadth of domain (therapeutic market focus)	Rx sales in 3 largest therapeutic areas/total sales	annual reports, Paul de Haen Drug Survey and New Product Analysis	pharmaceutical
Cool/Schendel (1987)	geographic scope	% of sales generated abroad	IMS, Paul de Haen New Drug Analysis and New Product Survey FDA, annual reports, 10-k reports	pharmaceutical
Bierly/Chakrabarty (1996)	knowledge dispersion	Index measuring technological dispersion over therapeutic areas (patents in different therapeutic areas)	Patent Office	pharmaceutical

Table 5: Previous operationlizations of business strategy, dimension1: breadth of domain.

Previous operationalizations of business strategy (objective indicators) - continued

Dimension 2: Resource committment/logic of generating competitive advantage (efficiency vs. new opportunites)				
Author	**Construct**	**Measures**	**Data Source**	**Industry**
Veliyath et al (1994),	Efficiency	sales/employees	Compustat, annual reports, 10-k forms	pharmaceutical
Veliyath et al (1994),	Efficiency	sales/assets	Compustat, annual reports, 10-k forms	pharmaceutical
Ittner/Larcker/Rajan (1997)	Efficiency	employees/sales	Annual reports, Lexis Nexis	cross - industry
Thomas/Litschert/ Ramas-wamy (1991)	Efficiency	sales/employees	annual reports, 10-k forms	electronic comput-ing equipment
Veliyath et al (1994),	Lack of efficiency	selling & general administrative expensive /sales	Compustat, annual reports, 10-k forms	pharmaceutical
Cool/Schendel (1987)	commitment to R&D	R&D expenditure/sales	IMS, Paul de Haen New Drug Analysis and New Product Survey FDA, annual reports, 10-k reports	pharmaceutical
Cool/Schendel (1987)	commitment to R&D	NDAs/INDs	see above	pharmaceutical
Yeoh/Roth (1999)	commitment to R&D	R&D/sales	annual reports, 10-k forms	pharmaceutical
Bierly/Chakrabarty (1996)	commitment to R&D	R&D expenditure/sales	annual reports, 10-k forms	pharmaceutical
Cool/Schendel (1987)	innovativeness	NCEs/NDAs	see above	pharmaceutical
Shortell/Zajac (1990)	innovativeness	no of high-tech services offered	American Hospital Association	health care (hospitals)
Yanadori/Marler (2006)	innovation strategy	R&D expenditure/employees	Compustat, annual reports, 10-k forms	high technology
Hambrick (1983)	relative commitment to new products	% sales from new products minus %sales from new products by 3 largest competitors	PIMS database	cross - industry
Thomas/Litschert/Ramaswamy (1991)	relative commitment to new products	no of new products introduced; R&D expenditure/sales	annual reports, 10-k forms	electronic comput-ing equipment
Ittner/Larcker/Rajan 1997	propensity to search for new products	R&D expenditure/sales	Annual reports, Lexis Nexis	cross - industry
Ittner/Larcker/Rajan 1997	growth potential	market to book value	Annual reports, Lexis Nexis	cross - industry
Yeoh/Roth (1999)	innovation radicalness	NCEs/NDAs	Paul de Haen Drug Survey and New Product Analysis	pharmaceutical
Bierly/Chakrabarty (1996)	Learning radicalness	NCEs/NDAs	FDA	pharmaceutical

Cool/Schendel (1987)	promotion focus	promotion/adverstising spending/sales	IMS, Paul de Haen New Drug Analysis and New Product Survey FDA, annual reports, 10-k reports	pharmaceutical
Thomas/Litschert/ Ramaswamy (1991)	market focus	marketing expenditure/sales	annual reports, 10-k forms	electronic computing equipment
Yeoh/Roth (1999)	sales focus	salesforce expenditure/sales	annual reports, 10-k forms, SCRIP	pharmaceutical

Table 6: Previous operationlizations of business strategy, dimension 2: resource commitment.

Other variables and controls				
Author	**Construct**	**Measures**	**Data Source**	**Industry**
Cool/Schendel (1987)	size of operations	ln(total domestic drug sales)	10-k forms, annual report	pharmaceutical
Boyd/Salamin (2001)	division size	no of employees	10-k forms, annual report	financial services
Yanadori/Marler (2006)	firm performance	Return on assets (ROA)	Compustat	high technology
Yanadori/Marler (2006)	market value	price-earnings ratio (P/E ratio)	Compustat	high technology
Yanadori/Marler (2006)	Liquidity	cash flow	Compustat	high technology

Table 7: Other variables used in empirical studies on strategic typologies.

Performance				
Author	**Construct**	**Measures**	**Data Source**	**Industry**
Thomas/Litschert/Ramaswamy (1991)	Financial performance	Return on investment (ROI)	annual reports, 10-k forms	electronic computing equipment
Thomas/Litschert/Ramaswamy (1991)	market-based performance	Market share	annual reports, 10-k forms	electronic computing equipment
Boyd/Salamin (2001)	Financial performance	EBIT	10-k forms, annual report	financial services
Veliyath et al (1994),	Financial performance	Return on Equity (ROE)	Compustat, annual reports, 10-k forms	pharmaceutical
Bierly/Chakrabarty (1996)	Financial performance	Return on Sales (ROS) and Return on Assets (ROA)	annual reports, 10-k forms	pharmaceutical

Table 8: Performance variables used in empirical studies on strategic typologies.

Dimensions, constructs and variables along with their operationalizations and data sources used in this research are summarized in table Table 9. I broadly grouped variables into three strategic dimensions: i) size, ii) breadth of domain and iii) resource commitment (new opportunities versus efficiency). "Size" variables capture organizational scale in terms of employees, assets, sales and R&D expenditure (data were averaged over a three-year period 2003 to 2005). "Breadth of domain" variables measure the companies' scope of activities and geographic focus. "New opportunities versus efficiency" consists of variables measuring various aspects of resource commitment like e.g. relative R&D expenditure, (radically) new products brought to the market and efficiency (sales/employees, sales/assets). A more detailed description of these variables and the way they were used in the analysis (either for the clustering process itself or for consecutive validation and profiling) will be given in chapter 6.2, where the analytical procedure of cluster analysis is described.

Strategic dimension	Construct(s)	Variable name	Operationalization	Comments	Data
size	size	av_rd	av. R&D spending (03-05)	R&D resources	1
	size	av_empl	av. No employees (03-05)		1
	size	av_assets	av. assets (03-05)		1
	size	av_sales	av. sales (03-05)	represents focus on downstream activities	1
breadth of domain	activity scope	therareas*)	therapeutic areas (count)	clustering variable	**3**
	geographic focus	salesint_ant	sales generated abroad = non U.S. sales (as % of total sales)		2
resource commit-ment & orientation towards change	efficiency	sales.empl	sales/employees	represents focus on downstream activities	1
	efficiency	sales.assets	sales/assets	see above	1
	R&D commitment	rd.sales*)	R&D expenditure/sales (av. 03-05)	clustering variable	**1**
	R&D commitment	rd.empl	R&D expenditure/empl. (av.03-05)		1
	R&D commitment	rd.assets	R&D expenditure/assets (av.03-05)		4
	innovation/new products	nda00*)	new products since 2000	clustering variable	**4**
	radical innovation	nme00; nme00nbla00	radically new products since 2000		4
	innovation	nda00nbla00	new products since 2000 +biologics		4
	commitment to radical innovation	nme00nbla00.empl nme00nbla00.sales	radically new products approved incl. biologics/employees or sales		1+ 4
	commitment to innovation	nda00.empl or sales	new products approved since 2000/employees or sales		1+ 4

*) used als clustering variable in analysis

Data Sources: 1= Compustat U.S.; 2 =Compustat Segments; 3= Windhover 4= FDA

Table 9: Key strategic variables used for cluster analysis, profiling and validation.

nr	Therapeutic areas	Description (Examples)
1	blood & coagulation disorders	e.g. anemia, blood storage, blood substitutes, blood volume, intravascular, iron disorders-anemia
2	cancer	e.g. B-cell lymphomona, blood cancer, breast cancer, oral cancer, skin cancer, tumors, uterine cancer
3	cardiovascular	e.g. abdominal aortic aneurysm, aneurysm, angina, angioplasty, cardiotonic, congestive heart failure
4	dental and oral products	e.g. canker sores, dry mouth, oral ulcers, plaque, etc.
5	dermatology	e.g. acne, dermatitis, itching, moisturizer, ringworm, skinaging, etc.
6	gastrointestinal	e.g. anti-emetic, cirrhosis, gastritis, inflammatory bowel diseas, laxative, ulcer, etc.
7	gynecological, urological	e.g. bladder, contraceptive, hormone replacement, incontinence, infertility, menopause, sexual dysfunction
8	hepatic (liver)	e.g. gallstone, liver failure
9	immunology	e.g. allergy, autoimmune disorders, bone marrow transplantation, organ transplantation, rejection
10	infectious & viral diseases (i&v) - antibacterial /antifungal	e.g. antibiotic resistance, leprosy, tetanus, sepsis, tuberculosis, etc.
10	i&v - antiviral	e.g. AIDS, Dengue Fever, Hepatitis A B C, Herpes, HIB, Influenza, Polio, Yellow Fewer, etc.
10	i&v - parasitic protozoa	e.g. hemorrhagic, schistosomiasi, creutzfeldt-jakob etc.
11	inflammation	inflammation
12	metabolic disorders	e.g. diabetes, eating disorders, glucose intolerance, obesity, potassium deficit, etc.
13	musculosketal & connective tissue disorders	e.g. arthritis, bone disorders, carpal tunnel syndrome, leg cramps, muscle atrophy, spinal disorders,
14	neurology, nervous system	e.g. ALS, alzheimer's disease, analgesic, anesthesia, anticonvulsant, brain injury, cognition
15	ophtalmic	e.g. artificial tear, contact lens, dry eye, retinitis, vision correction, etc.
16	otolaryngology	e.g. deafness, tonsillitis, etc.
17	poison	e.g. lead poisoning, nerve gas
18	renal system	e.g. end stage renal disease, kidney transplantation, nephropathy, etc.
19	respiratory, pulmonary	e.g. antihistmine, ARDS, Asthma, Bronchitis, Cough, Cold, Pertussis, Smoking Cessation
20	wound healing & tissue repair	e.g. antifibrotic, fibrosis, burn, dermal ulcers, hemorrhoid, keloid, pressure sores, etc.

Figure 12: Therapeutic areas. Source: Windhover SIS, 2006.

5.5.2 Measuring alliance portfolio configuration

As already described in great detail in chapter 3.5, I conceptualize a firm's alliance portfolio along three dimensions: network size, network diversity and tie strength. Prior research has established construct and predictive validity of these dimensions and used them in empirical studies on the effect of network resources on organizational behavior (Koka and Prescott, 2002; Lee, G. K., 2007)[30]. The specific resource and informational benefits associated with high levels of network size (quantity of resources), network heterogeneity (diversity of resources) and tie strength (quality of resources) have also been presented in chapter 3.5. Below, I will thus focus on the operationalization of network characteristics.

[30] In their study, Koka and Prescott (2002) examined information volume, richness and diversity.

Network size impacts the quantity of resources accessed

In network studies, the quantity of information accessed is usually conceptualized as degree-centrality, which is the number of direct links a company has with its partners (Ahuja, 2000a; Baum, et al., 2000; Hanneman and Riddle, 2005). In line with previous studies in this field (Koka and Prescott, 2002; Lee, G. K., 2007), I used both the *number of alliances* and the *number of partners* to measure network size. As both measures are highly related to firm size I employed the following (relative) measures for network size: i) "alliances.empl" (number of alliances per thousand employees), ii) "alliances.sales" (number of alliances relative to sales", iii) "alliancespartners.empl" (number of alliance partners per thousand employees), and iv) "alliancespartners.sales" (number of alliance partners relative to sales).

Network diversity impacts the novelty (non-redundancy) of resources accessed

In the social network literature, the concept of structural holes (Burt, 1992) is used to represent the degree of non-redundancy of contacts. However, Rodan and Galuncic (2004) convincingly show that a sparse network is not a guarantee for diversity of the information sourced. Scholars studying strategic alliances and networks have therefore increasingly used indices of partner diversity to capture the heterogeneity of network resources (Baum, et al., 2000; Koka and Prescott, 2002; Lee, G. K., 2007; Rodan and Galunic, 2004). I capture the diversity of a pharmaceutical company's alliance portfolio by two measures, that is *partner diversity* and *technological diversity*. Blau's heterogeneity index (Blau, 1977: 78) is used to calculate both measures of diversity. Blau's index takes values between 0 (completely homogeneous network) and 1 (completely heterogenous network)

$$\text{Blau's index: } d = 1 - \sum_{i=1}^{n} p_i^{\,2}$$

wereby d stands for diversity, n for the total number of categories and p for the percentage of objects in a particular category. For example, if a company has 10 alliances in total, with 2 alliances in each of the 5 different partner categories, network diversity is calculated as 1-(2/10)²+ (2/10)²+ (2/10)²+ (2/10)²+ (2/10)²= 1-0,2 = 0,8. Other studies in this field use either the Blau's heterogeneity index (Koka and Prescott, 2002; Lee, G. K., 2007) or other diversity indices such as Herfindahl-Hirschmann index that was originally developed to measure industry

concentration and is now employed to capture network diversity (Baum, et al., 2000) as well as the diversity of a firm's activities and/or products (Bogner, et al., 1996).

$$\text{Herfindahl – Hirschmann index:} \quad H = \sum_{i=1}^{n} p_i^{\,2}$$

While the underlying logic is the same as with Blau's diversity index, a high value (1) of the Herfindahl index obviously means the exact opposite, i.e. maximal homogeneity.

For *partner diversity*, I specified 8 categories prior to data collection and classified each alliance registered into one partner category during data collection and preparation. The goal was to come up with exhaustive and mutually exclusive, clear-cut categories so that any player could only be classified as one type based on its major activity. To come up with these categories, I followed a three-step procedure. First, I analyzed several dozens of textual alliance descriptions of diverse sample companies, which I retrieved from the SDC Platinum alliance database and Factiva, and came up with a rough draft of categories. Second, I searched reports and industry-specific literature (e.g. Seget, 2002) and complemented my categories. Finally, I talked to industry experts and scholars in the field to validate the suggested partner classification scheme[31]. Initially, I worked with the following categories: pharmaceutical - big pharma, pharmaceutical – other, biotechnology company, provider of technologies/research services. generics manufacturer, wholesaler/retailer, medical equipment provider, IT Services, Business Services, and Other. During and after data collection it turned out that some categories had to be dropped while others had to be included in the list due to the frequency of partner firms in the respective categories. Finally, I used the categories described in table Table 10 to calculate network diversity measures for the sample firms.

To measure *technological diversity*, I calculated Blau's index based on the mix of a company's deals across therapeutic areas. Via Windhover, I collected data on the "product therapeutic category" of each deal. In addition to the 20 categories displayed in Figure 12, I introduced a category entitled "technology and discovery" to capture all pure technology deals and deals in a very early stage in the discovery process, which would otherwise not be accounted for.

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partner type	category description
big pharma	categorized as one of 20 Big pharma in Windhover database
pharmaceutical - other	pharmaceutical company (excluding big pharma)
biotechnology company	mentioned as biotechnology company in SDC or biotech/start-up in Windhover; typically SIC code = 2836
provider of technologies or research services	company that focuses on (research and technology) services rather than on manufacturing (typically SIC 8731)
generics manufacturer	majority (>50%) of sales in generics
uni	university department or research institute
medical equipment provider	companies that produce any equipment/apparatus needed in the drug development and delivery process
IT/Business services	Software providers, IT service/ consulting companies, etc.
Other	Any company not attributable to the above defined categories, e.g. if present in non-related industries

Table 10: Partner type classification scheme.

Tie strength impacts the quality of resources accessed

Granovetter (1973: 1361) defines tie strength as the "…combination of the amount of time, the emotional intensity, the intimacy (mutual confiding) and the reciprocal services which characterize the tie". Tie strength, or relational embeddedness, is related to higher quality of information exchanged and the possibility to use informal governance mechanisms, but also to higher resource commitment and mutual dependency (Uzzi, 1996, 1997). Following previous research, I use multiple and repeated ties (Koka and Prescott, 2002; Lee, G. K., 2007) as well as different alliance types (Rowley, et al., 2000) as proxies for tie strength.

The assumption with *multiple and repeated ties* is that the relationship with an alliance partner gets stronger with the growing number of jointly mastered projects and activities. Multiple ties refer to more than one alliance with the same partner at a point of time and repeated ties are entered into over time. I measure them in one variable termed "repeatedalliances_r", which is calculated by subtracting the number of partners from the number of alliances and dividing the result by the total number of alliances[32].

Accounting only for multiple and repeat ties to capture tie strength would imply that strong and weak ties are different by degree only. However, the nature of weak and strong ties is different in both type and degree (Granovetter, 1985; Uzzi, 1996). Therefore, following Rowley et al. (2000),

I also collected data on the *type of alliances* entered into and classified each alliance according to its nature. To come up with the scheme, I followed a three-step procedure similar to the procedure used for generating the alliance partner classification scheme. First, I analyzed several dozens of textual alliance descriptions of various sample companies (sources: SDC Platinum alliance database and Factiva press releases) and came up with a first draft of dimensions and categories. Second, I searched reports and industry-specific literature (e.g. Seget, 2002) and complemented the categories. Finally, I talked to industry experts and scholars in the field to validate the suggested alliance type classification scheme[33]. The aim was to come up with a scheme that could represent the "strength" of a relationship (in terms of commitment, trust and risk involved). Typically, the more equity is involved, the "stronger" is the relationship. Table 11 shows the final classification scheme. Consequently, every alliance of the sample firm was coded between 1 and 5 to represent the strength of the tie.

no	alliance type	comments, description
5	joint venture	stated as such in press release, usually % are given
4	deal includes equitiy investment	equity investment by commercial strategic partner; typically combined with licensing or any other contractual agreement
3	exclusive licensing	rights/services are exclusively exchanged for $ (upfront payments, royalty fees)
2	licensing	always stated as such in the SDC deal descriptions and press releases; rights/services are exchanged for $ (upfront payments, royalty fees)
1	other contractual agreement	any strategic alliance NOT marked as JVs or licensing agreement, typically a codevelopment or any strategic buyer-supplier relationship
1	product acquisition	stated as such in press release

Table 11: Alliance type classification scheme.

To measure *tie strength* on the portfolio level, I took the arithmetic average of the alliance codes for each alliance portfolio. Moreover, I also calculated "*strong ties*" and "*weak ties*" as alternative measures for tie strength. "Strong ties_1" is defined as the share of joint ventures and

[32] In a similar vein, Lee, G. K. (2007) uses the ratio of alliances to alliance partners to capture multiple ties with the same partner.
[33] I want to thank Karan Girotra (Operations and Information Management, The Wharton School), Neal Mueller (MBA, The Wharton School), Gary Kaplanovich (Director Finance, Strategic Business Analysis, Sanofi Aventis) and Marc Ceulemans (Head of Finance – Business Development and Licensing, Novartis Pharma AG) for their helpful comments and suggestions to improve the scheme.

equity alliances in total alliances. “Strong ties_2” is calculated similarly but also included exclusive licensing agreements. “Weak ties_1” includes only simple contractual agreements and product acquisitions, while “weak ties_2” captures the latter plus simple licensing agreements (see Table 16 on page 145 for an overview of network variables used in the analysis).

6 Step 1: Identifying homogeneous strategic types

Cluster analysis was chosen as multivariate technique to group sample companies according to their strategic orientation as measured by a theory-based set of strategic variables. *I propose that organizations within the same industry pursue distinctly dissimilar strategies. Organizations with similar strategies within the same industry can be clustered into a limited number of strategic types.* The variables used for cluster analysis are based on existing theory in the field, particularly previous operationalizations of Miles and Snow's (1978) strategic types defender, analyzer and prospector. The aim of this analysis is i) to generate groups of companies with distinctly dissimilar strategies and ii) to compare the empirically derived findings with the strategic typologies proposed in the literature (Miles and Snow, 1978; Zammuto, 1988).

After a brief introduction into general aspects of cluster analysis, I will present the analytical clustering, followed by a detailed description of results.

6.1 An introduction to cluster analysis

Cluster analysis is one of the most widely used multivariate interdependence techniques. The primary objective of interdependence techniques – as opposed to dependence techniques (e.g. regression analysis) – is to identify the structure among a given set of variables or objects, without assessing any dependence relationship. While factor analysis focuses on the structure of *variables*, cluster analysis focuses on *objects* and groups them into clusters by maximizing intra-group homogeneity and inter-group heterogeneity. Moreover, factor analysis bases its groupings on patterns of variation (correlation), whereas cluster analysis is based on distance (or rather: proximity) (Bühl, 2006; Hair, et al., 2006: 559).

Cluster analysis is the only multivariate technique that doesn't estimate the variate empirically but instead employs the variate specified by the researcher to compare objects based on this variate. Therefore – more than any other multivariate technique – cluster analysis is dependent on the measures used to characterize objects and results are highly affected by the choice of measures used in the analysis. Therefore, cluster analysis should be lead by strong theory and should be applied in a rather confirmatory mode to identify groups that already have strong conceptual support (Hair, et al., 2006: 561).

6.2 Analytical procedure

For the purpose of generating clusters from my sample I followed the cluster analysis decision process as suggested by Hair et al. (2006: 568). Cluster analysis offers multiple means to measure distance and to specify the clustering algorithm. Any decisions concerning the analytical procedure should be based on the specific research problem as well as data characteristics.

6.2.1 Specification of research objective and selection of clustering variables

The **objective of this analysis** is to empirically derive a classification of sample companies and to compare the empirical solution to the theoretically founded typology.

When **selecting the clustering variables**, theoretical, conceptual and practical aspects have to be considered. More specifically, variables should i) optimally characterize the objects being clustered and ii) relate specifically to the objectives of the analysis. Variables that do not differ significantly across clusters derived should be eliminated from the analysis (Hair, et al., 2006). I followed the deductive approach (Ketchen, D. J., et al., 1993; Ketchen, D. and Shook, 1996: 443) and strongly tied variables (as well as the number of clusters expected) to theory. Irrelevant variables are not recognized by the algorithm and may lead to false results. Therefore, I aimed at selecting only a limited number of key variables with a sound theoretical background for the actual clustering procedure. In order to get a better "feel" for the data and see which variables would be highly distinctive, I plotted the data by selecting two strategic variables at a time. Scatterplots uncover the bivariate relationship between any two variables, thus I could identify correlations and the effect certain variables would have if used in cluster analysis. As my sample is highly skewed towards smaller number (that is, there is only a small number of large companies but a large number of very small companies), I did separate analysis with a limited sample of only 69 companies (excluding companies with an R&D/sales ratio of >50%) to get less crowded scatterplots. Results were promising, as I found that both therapeutic areas and R&D/sales were highly distinctive, not correlated variables that would perform well in subsequent cluster analyses (see Figure 13). Both clustering variables as well as variables used for cluster validation and profiling are listed in Table 9, chapter 5.5.1.

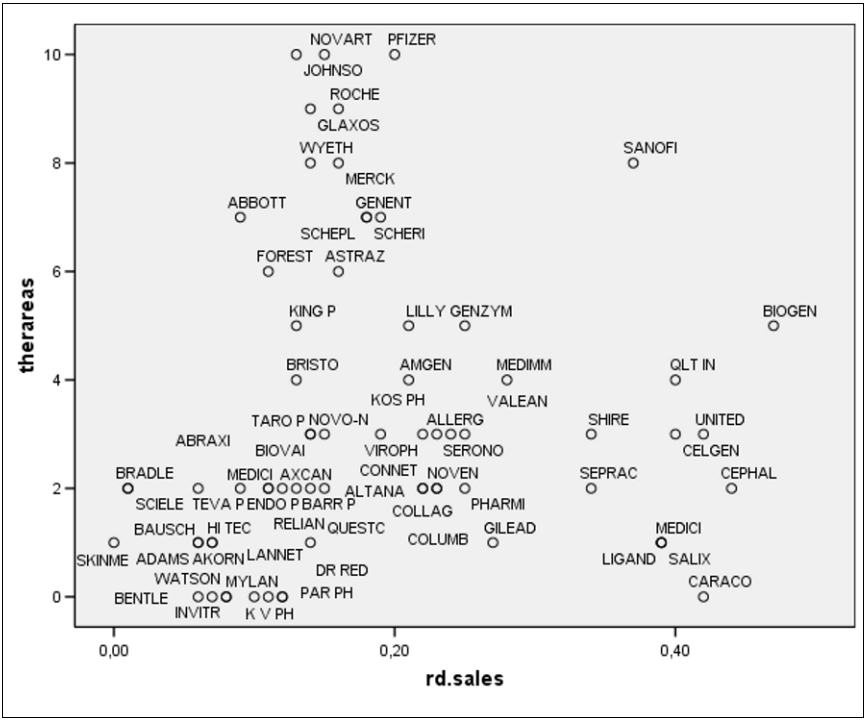

Figure 13: Scatterplot (therapeutic areas, R&D/sales), N=69 (rd.sales <0,5 excluded).

The breadth of pharmaceutical activities is best represented by the number of therapeutic areas a company is active in. I used Windhover's classification of 20 distinct therapeutic areas to determine a firm's breadth of domain (see Figure 12 on page 115). In order to account for the scope corporate activities, I used the variable **"therareas"**, which represents a simple count measure of the therapeutic areas the given company is active in.

Arguably the most relevant type of resource commitment in the pharmaceutical industry is R&D expenditure. Related to total sales, it represents the relative importance of research and development activities in the organization. I withdraw data from Compustat U.S. and calculated the variable **"rd.sales"** as R&D spending divided by sales, whereby I used 3-year averages (2003-2005) for both R&D and sales figures.

Whereas R&D expenditure is an input measure, the number of NDAs and/or NMEs is used to account for a firms innovation output. New drug applications are filed with the FDA and represent a company's rate of new product development. New molecular entities are new drugs that involve an entirely novel molecule and can therefore be described as radically new drugs. I used the variable **"nda00"**, the aggregate of a company's new drug approvals since 2000 to capture innovation output and development skills in general. Obviously, this variable stands for more than just innovation output and will generally indicate also a relatively large firm size and a focus on downstream activities (late-stage development and commercialization).

I decided to use the remaining variables (e.g. the percentage of international sales to total sales, or sales per employee, etc.) for cluster profiling and validation, as including more than three variables into the clustering procedure never lead to better results. More specifically, including more variables generally lead to larger increases in the agglomeration coefficient (which indicates intra-cluster heterogeneity), more fragmented cluster solutions, and less distinctive cluster profiles.

6.2.2 Research design issues and descriptive statistics

After the specification of variables, several critical research design issues need to be addressed before the actual analysis can be performed: i) sample size, ii) outliers and normal distribution, iii) multicollinearity of variables and iv) data standardization.

Issues of **sample size** in cluster analysis do not relate to issues of statistical inference, but rather to the fact that small groups within the population should be represented in the sample. Large samples simply increase the chance that even smaller groups are well represented. However, if the researcher is mainly interested in detecting the major groups within the population, the distinction between an outlier and the member of a small group becomes less important.

As my sample covers essentially the entire population of U.S.-listed pharmaceutical companies (except for very small or young companies that could not be included due to data availability problems), sample size issues are less important for this analysis. However, I tried to work with as large a sample as possible to make subsequent analyses (that is the comparison of alliance portfolios across groups) easier and more meaningful. While I aimed at a sample size of roughly 100 companies, I ended up with 98 companies (see chapter 5.2.2 for a detailed sample description).

To detect **outliers** and any divergence from a **normal distribution**, I examined the data graphically by drawing simple univariate diagrams, bivariate scatterplots and boxplot diagrams. An efficient way to better understand the data is to draw scatterplots from different pairs of variables. Apart from sales/assets and sales/employees, the data generally doesn't follow a normal distribution (see results of K-S test for normal distribution in Figure 14). Although normal distribution is not a precondition for performing cluster analysis, it will become more important for running comparisons of means across groups later on. Descriptive statistics of key variables are displayed in Figure 15.

One-Sample Kolmogorov-Smirnov Test

		therareas	av_sales	rd.sales	nda00	sales.empl	sales.assets	salesint_ant
N		98	98	98	98	98	98	98
Normal Parameters[a,b]	Mean	2,80	4117,1463	,5615	3,69	362,5693	,4893	,2801
	Std. Deviation	2,516	9627,174	,74143	6,603	232,19653	,27861	,33688
Most Extreme Differences	Absolute	,226	,369	,259	,288	,119	,085	,244
	Positive	,226	,369	,259	,288	,119	,085	,244
	Negative	-,133	-,335	-,224	-,288	-,098	-,081	-,203
Kolmogorov-Smirnov Z		2,239	3,649	2,568	2,850	1,178	,839	2,419
Asymp. Sig. (2-tailed)		,000	,000	,000	,000	,124	,482	,000

a. Test distribution is Normal.

b. Calculated from data.

Figure 14: Kologmorov-Smirnov Test for normal distribution of key variables.

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
therareas	98	2,80	2,516	0	10
av_sales	98	4117,1463	9627,17371	10,61	49667,33
rd.sales	98	,5615	,74143	,00	4,92
nda00	98	3,69	6,603	0	40
sales.empl	98	362,5693	232,19653	62,66	1350,05
sales.assets	98	,4893	,27861	,10	1,52
salesint_ant	98	,2801	,33688	,00	,99

Figure 15: Descriptive statistics for key strategic variables.

Cypress Bioscience and Cell Therapeutics were identified as outliers in several scatterplots, mainly due to their high R&D/sales (Cell Therapeutics: 4.92) and high R&D/employees ratio (Cypress Bioscience: $952.11 million), whereupon sample size was reduced to N=96.

Unlike other multivariate techniques, cluster analysis is not a tool for drawing statistical inferences. In this way, it has more mathematical than statistical characteristics. While the

questions of normality and homoscedasticity (as essential to regression analysis) are not that important for performing cluster analysis, issues of multicollinearity among variables are indeed critical to the analysis.

Multicollinearity acts as implicit weighting in cluster analysis. Therefore, care has to be taken to avoid multicollinearity by either eliminating some of the correlated variables (to have an equal number of correlated variables in each group) or by employing a distance measure that automatically compensates for correlations (e.g. Mahalanobis distance) (Hair, et al., 2006: 582).

I did scatterplots and correlation tables to identify correlated variables and eliminated some to have equally sized groups of correlated variables (see Figure 16). Obviously, therapeutic areas and R&D/sales are not correlated. The moderate and significant relationship between nda00 and therapeutic areas is probably due to the fact that both variables are related to size. Nda00 is related slightly negatively to R&D/sales, which points at the potential trade-off between commitment to R&D activities and actually pushing products to the approval stage and commercializing them.

Correlations

			therareas	av_empl	av_sales	av_rd	rd.sales	nda00
Spearman's rho	therareas	Correlation Coefficient	1,000	,577**	,595**	,633**	-,045	,581**
		Sig. (2-tailed)	.	,000	,000	,000	,657	,000
		N	98	98	98	98	98	98
	av_empl	Correlation Coefficient	,577**	1,000	,952**	,877**	-,428**	,730**
		Sig. (2-tailed)	,000	.	,000	,000	,000	,000
		N	98	98	98	98	98	98
	av_sales	Correlation Coefficient	,595**	,952**	1,000	,855**	-,512**	,799**
		Sig. (2-tailed)	,000	,000	.	,000	,000	,000
		N	98	98	98	98	98	98
	av_rd	Correlation Coefficient	,633**	,877**	,855**	1,000	-,049	,691**
		Sig. (2-tailed)	,000	,000	,000	.	,634	,000
		N	98	98	98	98	98	98
	rd.sales	Correlation Coefficient	-,045	-,428**	-,512**	-,049	1,000	-,381**
		Sig. (2-tailed)	,657	,000	,000	,634	.	,000
		N	98	98	98	98	98	98
	nda00	Correlation Coefficient	,581**	,730**	,799**	,691**	-,381**	1,000
		Sig. (2-tailed)	,000	,000	,000	,000	,000	.
		N	98	98	98	98	98	98

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 16: Nonparametric correlations among key strategic variables (Spearman's rho).

6.2.3 Selection of similarity measure and clustering algorithm

The concept of interobject similarity is fundamental to cluster analysis. Broadly speaking, for metric data, there are two approaches to measuring the similarity of objects, namely i) correlational measures, and ii) distance measures. Correlation is measured between two objects on several variables and represents the correspondence of patterns across the characteristics. Thus, a correlational measure of similarity doesn't look at the magnitude of the values but instead at the patterns of these values – it compares profiles, not individual values. Typically, however, the focus in cluster analysis lies on the magnitude of values and not so much on the correlation of profiles. Distance measures capture similarity (or dissimilarity) as proximity between objects and are commonly applied in cluster analysis (Hair, et al., 2006: 575)

Yet even among distance measures, there are several options to choose from. I used squared Euclidian distances, which is the recommended measure for metric data and the Ward's methods of clustering (Bühl, 2006; Hair, et al., 2006). Euclidean distance is the straight-line distance between two points in a two-dimensional space, calculated as the length of the hypotenuse of a right triangle (see Figure 17). If the square root is not taken, the measure is called squared (or absolute) Euclidean distance.

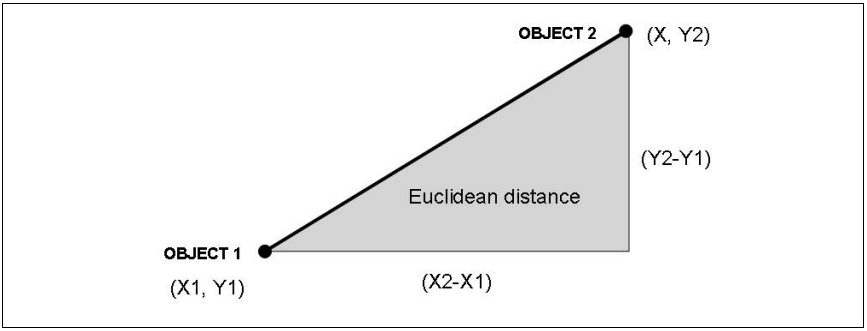

Figure 17: Euclidean distance. Source: Hair et al. (2006)

Euclidean distance is calculated as:

$$d = \sqrt{\left(X_2 - X_1\right)^2 + \left(Y_2 - Y_1\right)^2}.$$

Obviously, cluster analysis is sensitive to differing scales or magnitudes among the variables. Broadly speaking, variables with larger dispersion (i.e. a larger standard deviation) will have more impact on the calculated similarity value. Therefore, I **standardized variables** by converting them to standard scores, which is done by subtracting the mean and dividing by the standard deviation for each variable. Transformation to Z scores can be performed by the SPSS 11.5[34] software before running the clustering algorithm.

Before actually running the analysis I still had to select an adequate clustering algorithm. Essentially, there are two different approaches to generating clusters: i) hierarchical methods and ii) nonhierarchical methods.

Hierarchical procedures involve a series of n-1 clustering decisions (n equals the number of observations) that combine objects into a treelike structure. **Agglomerative hierarchical algorithms** start out with n clusters and combine the two most similar clusters until there is only one cluster left. In contrast, divisive methods start out with one huge cluster that is successively divided until each object rests in its own cluster. Agglomerative procedures are by far more commonly used in the literature (Hair, et al., 2006). Arguable the most important characteristic of hierarchical methods (as opposed to nonhierarchical ones) is that early formed clusters are always nested in later results or, put differently, clusters are always formed by joining two already existing clusters and cluster members are not reassigned at a later stage. While this feature bears certain advantages (i.e. simplicity, clear structure, and the fact that cluster members can be traced back all the way to the start), the disadvantage is that possibly suboptimal early combinations persist until the end and impact the final results of the cluster analysis. Therefore, particular care has to be devoted to the identification of outliers which may distort results if not dealt with in an appropriate way.

Within hierarchical methods, several clustering algorithms are available that define the rule on which cluster combination is based. More specifically, the clustering algorithm determines how similarity is calculated between two clusters with multiple members. Options include the single-linkage or nearest-neighbor method (where the similarity is measured between the closest neighbors of two clusters), the complete-linkage or farthest neighbor method (where similarity is based on the most distant objects of two clusters) and the average linkage method (which is based on the average distance between all members of cluster A to all members of cluster B).

[34] I used SPSS 11.5 for Windhows (a statistical software package) to run the cluster analysis.

Ward's method is commonly applied in strategic management research and differs from the other methods in that the similarity is measured as the sum of squares within the clusters summed over all variables (Aldenderfer and Blashfield, 1984; Hair, et al., 2006: 43). Essentially, the Ward's method captures intra-cluster homogeneity and combines clusters with the lowest within-cluster sum of squares. The Ward's method is particularly sensitive to outliers and should be employed if i) clusters are expected to be of roughly equal sizes and ii) there are no outliers (Ketchen, D. and Shook, 1996: 445). As I expect to find roughly equally sized clusters and outliers were eliminated, I opted for the Ward's method, which is also used most commonly with the squared Euclidean distances as similarity measure.

After running several cluster analyses, including variations in methods and/or variables used, I found that the existence of "pure" biotechnology companies (i.e. those ranked by both GICS and SIC classifications as biotechnology companies) were the cause for distorted and non-satisfying results. After eliminating those six companies (Amgen, Biogen Idec, Genzyme, Gilead Sciences, Invitrogen, Medimmune, Serono SA[35]), I arrived at a **final sample of 89 companies** and achieved significantly more meaningful results.

6.2.4 Deriving Clusters

Final clustering results are presented in Table 12. I ran the analysis for n=89 companies, involving three key strategic variables (that is, the number of therapeutic areas, R&D/sales ratio and the number of NDAs) using Ward's method and squared Euclidean distances as similarity measures. I standardized data to Z-scores. Determining the final number of clusters is an essential yet difficult task in both hierarchical and nonhierarchical methods. If hierarchical methods are employed, the researcher has to decide when to stop the procedure of combining clusters. Although there is no standard objective decision rule (like the standard significance tests with other multivariate methods), a common approach is to analyze the increase in heterogeneity that comes for the reduction of clusters (Hair, et al., 2006). Heterogeneity is measured as distance or within-cluster sum of squares (depending on whether distance measures or Ward's method is used) and the percentage increase in heterogeneity (referred to as agglomeration coefficient in SPSS) is calculated.

[35] Serono was acquired by Merck in September 2006 while I was writing up this report – yet another sign that boundaries between the pharmaceutical and the biotechnology industries might blur in the near future.

Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	18	73	,000	0	0	43
2	28	59	,000	0	0	8
3	25	57	,000	0	0	11
4	46	48	,000	0	0	47
5	49	80	,000	0	0	9
6	6	35	,000	0	0	17
7	3	15	,000	0	0	52
8	28	41	,001	2	0	34
9	14	49	,001	0	5	36
10	27	77	,002	0	0	26
11	25	61	,002	3	0	27
12	2	30	,003	0	0	33
13	16	45	,006	0	0	34
14	9	13	,008	0	0	33
15	43	82	,012	0	0	25
16	22	75	,017	0	0	29
17	6	76	,025	6	0	28
65	33	42	4,870	45	0	81
66	21	38	5,305	51	54	78
67	4	29	5,811	44	32	80
68	3	16	6,320	52	50	71
69	2	14	6,940	62	61	73
70	7	10	7,804	57	63	79
71	3	20	8,679	68	59	82
72	8	32	9,556	60	53	77
73	2	22	10,463	69	55	82
74	12	27	11,579	58	56	79
75	1	50	12,773	64	48	84
76	34	56	14,051	49	0	83
77	8	19	15,640	72	0	81
78	5	21	17,540	0	66	80
79	7	12	20,475	70	74	85
80	4	5	23,991	67	78	85
81	8	33	27,792	77	65	84
82	2	3	32,835	73	71	87
83	34	60	38,491	76	0	86
84	1	8	46,557	75	81	86
85	4	7	60,955	80	79	87
86	1	34	90,390	84	83	88
87	2	4	146,721	82	85	88
88	1	2	264,000	86	87	0

Table 12: Clustering results – agglomeration schedule

Let's examine the last three stages in the clustering process of Table 12. In stage 86, clusters 1 and 34 are combined to form 3 clusters and the agglomeration coefficient (which represents the within-cluster sum of squares and should be checked for large changes) increases by roughly 48% from 60.955 to 90.390. This is already quite a large increase if compared to earlier stages where the coefficient increased by 20-30%. In stage 87, the number of clusters is reduced to 2

and the coefficient increases sharply by roughly 62.3% to 146.721. Stage 88 would be the last stage to finally combine all objects into one single cluster, with the coefficient reaching a level of 264.0 (an increase of 80%). I chose to stop at a three-cluster solution as the agglomeration coefficient would have increased dramatically if I continued with the two-cluster solution. Looking only at this data, I could also have chosen a four-cluster solution, which turned out to equal the three-cluster solution except for the four largest pharmaceuticals ending up in their own cluster. Although these results point out that there is some heterogeneity even within the cluster "Big Pharma", I decided to continue with three clusters as, from a strategic and practical point of view, it wouldn't make sense to analyze four out of 20 big pharmaceuticals in a separate cluster.

The final three-cluster solution is presented in Figure 18 including some key figures (cluster averages) and a full list of each cluster's members. Already at first sight clusters show distinct profiles. Cluster 1 obviously comprises large, diversified pharmaceuticals. Cluster 3 consists of rather small, R&D-driven entrepreneurial companies. Finally, cluster 2 represents the largest group of pharmaceutical companies, which seem to be more focused and efficiency-oriented. In the following chapter, the process of cluster profiling, validation and finally interpretation will shed more light on the distinct cluster characteristics and the strategic orientation of their members.

6.3 Results

The last stage of cluster analysis involves a careful validation, profiling and interpretation of the clusters derived. The empirically derived cluster solution is presented in Figure 18.

6.3.1 Cluster profiling and validation

Cluster validation is necessary to assure that the results are representative of the underlying population and generalizable to other situations. A common way to establish criterion (or predictive) validity is to select strategic variables that have strong theoretical or empirical support but were not used in the cluster analysis per se and compare their mean values (cluster centroids) across clusters (Hair, et al., 2006: 597). The same process also helps to get a clearer picture of each cluster's specific profile.

key figures (averages)	Cluster 1	Cluster 2	Cluster 3
N	20	41	28
sales ($mio)	17630	688	82
R&D/sales	18%	18%	130%
therap.areas	6.8	1.7	2,6
NDAs	12.45	1.53	0.29
cluster members	ABBOTT LABORATORIES ALLERGAN INC ASTRAZENECA PLC BIOVAIL CORP BRISTOL-MYERS SQUIBB CO FOREST LABORATORIES GENENTECH INC GLAXOSMITHKLINE PLC JOHNSON & JOHNSON KING PHARMACEUTICALS INC LILLY (ELI) & CO MERCK & CO NOVARTIS AG PFIZER INC QLT INC ROCHE HOLDINGS LTD SANOFI-AVENTIS -ADR SCHERING AG -ADR SCHERING-PLOUGH WYETH	ABRAXIS BIOSCIENCE INC ADAMS RESPIRATORY THERAPTCS AKORN INC ALTANA AG -ADR AXCAN PHARMA INC BARR PHARMACEUTICALS INC BAUSCH & LOMB INC BENTLEY PHARMACEUTICALS BRADLEY PHARMACEUTICL CARACO PHARMACEUTICAL LABS CELGENE CORP COLLAGENEX PHARMACTCLS INC COLUMBIA LABORATORIES INC CONNETICS CORP DR REDDYS LABS LTD -ADR ENDO PHARMACEUTICALS HLDGS HI TECH PHARMACAL CO INC K V PHARMACEUTICAL KOS PHARMACEUTICALS INC LANNETT CO INC LIGAND PHARMACEUTICAL MEDICINES CO MEDICIS PHARMACEUT CP MYLAN LABORATORIES INC NOVEN PHARMACEUTICALS INC NOVO-NORDISK A/S PAR PHARMACEUTICAL COS INC PHARMION CORP QUESTCOR PHARMACEUTICALS INC RELIANT PHARMA INC -REDH SALIX PHARMACEUTICALS LTD SCIELE PHARMA INC SEPRACOR INC SHIRE PLC -ADR SKINMEDICA INC -REDH TARO PHARMACEUTICAL INDS LTD TEVA PHARM INDS UNITED THERAPEUTICS CORP VALEANT PHARMACEUTICALS INTL VIROPHARMA INC WATSON PHARMACEUTICALS INC	ADOLOR CORP ADVANCIS PHARMACEUTICAL ALKERMES INC AMYLIN PHARMACEUTICALS INC AUXILIUM PHARMA INC CARDIOME PHARMA CORP CEPHALON INC CUBIST PHARMACEUTICALS DURECT CORP FLAMEL TECHNOLOGIES ICOS CORP IMMUNOGEN INC INSPIRE PHARMACEUTICALS ISIS PHARMACEUTICALS INC KOSAN BIOSCIENCES INC MGI PHARMA INC NEKTAR THERAPEUTICS NEUROCRINE BIOSCIENCES NITROMED INC POZEN INC REGENERON PHARMACEUT SCICLONE PHARMACEUTICALS SUPERGEN INC TANOX INC VERNALIS PLC -ADR VERTEX PHARMACEUTICALS VIVUS INC WESTAIM CORP

Figure 18: Final 3-cluster-solution.

Typically, ANOVA[36] is used to compare means across distinct groups. One-way ANOVA is used to compare three or more groups on measures that are available on interval or ratio scales (Diamantopoulos and Schlegelmilch, 2000: 174). As several tests (Kologorov-Smirnov, Shapiro-Wilk test and visual inspection of the data) pointed to the fact that the normality assumptions

[36] ANOVA=Analyis of Variance. See chapter 7 for a detailed description of this statistical procedure.

were most likely violated, I decided to also run the Kruskal-Wallis ANOVA, which was developed for ordinal data and data that is not normally distributed.

The cluster profiles are displayed in Figure 19. Each horizontal line displays a cluster's unique profile along key strategic variables plotted on the x-axis (clustering variables are marked with an asterisk). Values on the vertical scale (y-axis) are based on effect size and were calculated by taking the difference between a cluster's mean value μ_1 and the overall mean value μ_2 and dividing it by the overall standard deviation SD:

$$\text{Values for x-axis (relative effect size)} = \frac{\mu_1 - \mu_2}{SE}$$

T-statistics as used in a t-test to compare two groups are calculated in a similar way, except that one group mean is subtracted from the other and the result is subsequently divided by the standard error SE. For the purpose of creating cluster profiles, I wanted to compare each cluster's characteristics to the overall mean values. Strategic variables were grouped into five dimensions, i.e. size, scope, efficiency, innovation (that is: commitment to innovation), and a last category that represents primarily innovation and size but also a focus on market-related activities.

Cluster 1 consists of large, highly diversified and internationally active pharmaceuticals with slightly above average operational (i.e. sales-related) efficiency, especially when it comes to sales per new product (sales/nda). Commitment to R&D and efficiency in innovation are remarkably low, whereas absolute output in terms of new products is again large – clearly due to the overall size of the businesses an their focus on marketing and sales activities.

Cluster 2 members are – compared to industry average – rather small and focused companies with average commitment to international sales. They score remarkably high on all efficiency measures, above all in sales. The relatively low sales/new products ratio seems to point at the fact that blockbusters are rather the business of cluster 1 members. R&D commitment is low, as well as the overall number of new products brought to the market, which is in line with their overall rather small business scale.

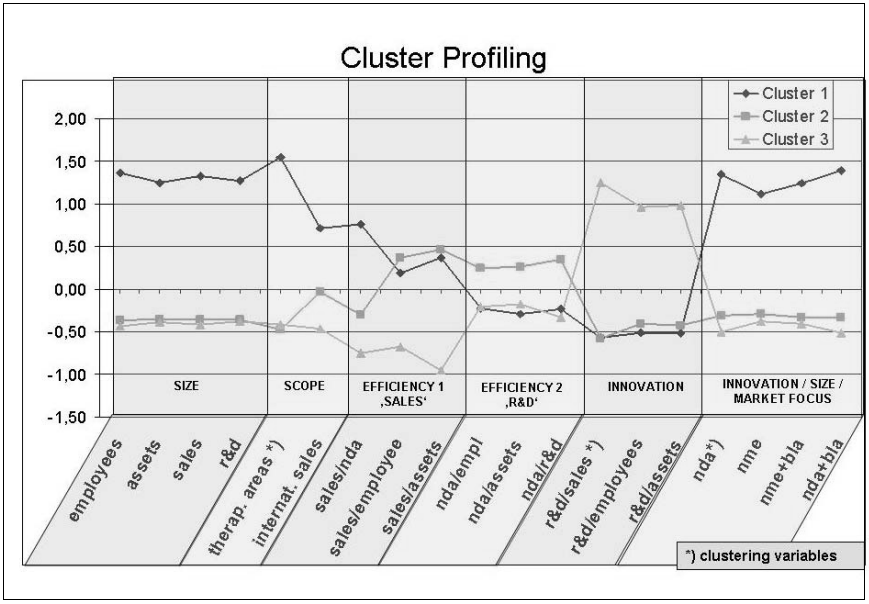

Figure 19: Cluster profiling.

Cluster 3 consists of small and focused companies that are mostly active in the domestic market. They score lowest on efficiency measures, although they're even slightly better in R&D efficiency than cluster 1 members. The most significant characteristic of cluster 3 members is their high R&D commitment. However, they score low on new products, even when related to their size (employees).

In addition to the graphical profiling, I validated the derived cluster solution by comparisons of means. ANOVA results (as displayed in Table 13) show that clusters differ significantly from each other on all strategic variables (mostly $p<0.01$, only two variables at $p<0.1$: nda/employees and nda/assets). As already mentioned above, I also ran the Kruskal-Wallis One-Way ANOVA, which lead – unsurprisingly – to the same results. The variables "nda/employees" and "nda/assets" were less significant than the others ($p<0.01$), but still reached a level of $p<0.05$).

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
therareas	Between Groups	413,494	2	206,747	102,856	,000
	Within Groups	172,866	86	2,010		
	Total	586,360	88			
salesint_ant	Between Groups	1,952	2	,976	9,756	,000
	Within Groups	8,606	86	,100		
	Total	10,558	88			
av_empl	Between Groups	33726,108	2	16863,054	52,451	,000
	Within Groups	27649,022	86	321,500		
	Total	61375,129	88			
av_assets	Between Groups	1,4E+010	2	7090354027	36,145	,000
	Within Groups	1,7E+010	86	196161899,0		
	Total	3,1E+010	88			
av_sales	Between Groups	4,6E+009	2	2293547140	45,997	,000
	Within Groups	4,3E+009	86	49862891,16		
	Total	8,9E+009	88			
av_rd	Between Groups	1,3E+008	2	63879158,89	39,200	,000
	Within Groups	1,4E+008	86	1629589,211		
	Total	2,7E+008	88			
sales.empl	Between Groups	969077,2	2	484538,603	11,797	,000
	Within Groups	3532428	86	41074,745		
	Total	4501505	88			
sales.assets	Between Groups	3,014	2	1,507	31,755	,000
	Within Groups	4,081	86	,047		
	Total	7,095	88			
rd.sales	Between Groups	24,039	2	12,019	114,867	,000
	Within Groups	8,999	86	,105		
	Total	33,037	88			
rd.empl	Between Groups	448523,2	2	224261,592	32,382	,000
	Within Groups	595600,4	86	6925,586		
	Total	1044124	88			
rd.assets	Between Groups	,469	2	,235	35,500	,000
	Within Groups	,568	86	,007		
	Total	1,037	88			
nda00	Between Groups	2048,579	2	1024,289	50,485	,000
	Within Groups	1744,859	86	20,289		
	Total	3793,438	88			
nme00	Between Groups	126,770	2	63,385	24,993	,000
	Within Groups	218,107	86	2,536		
	Total	344,876	88			
nda00.empl	Between Groups	95,316	2	47,658	2,432	,094
	Within Groups	1685,259	86	19,596		
	Total	1780,575	88			
nda00.assets	Between Groups	,000	2	,000	2,866	,062
	Within Groups	,005	86	,000		
	Total	,005	88			
nda00.rd	Between Groups	,029	2	,014	4,940	,009
	Within Groups	,249	85	,003		
	Total	,278	87			
sales.nda00	Between Groups	13400902	2	6700451,104	12,652	,000
	Within Groups	28598985	54	529610,841		
	Total	41999888	56			

Table 13: One-Way ANOVA on key strategic variables.

6.3.2 Cluster interpretation and conclusions

The interpretation of clusters involves analyzing the raw data to get a better feel for the cluster characteristics across all variables. I will build on the cluster profiles (see Figure 19 on page134) to further describe the clusters and compare the empirical solution to the typologies suggested by theory. More specifically, the goals of this process are i) to get a clearer picture of strategic communalities within clusters, ii) to compare the profiles to the theoretical typologies as described in chapter 3.4.6. and iii) to either confirm existing typologies or come up with an adapted version to better fit the reality of today's dynamic and alliance–driven business environment. In addition to the graphical profiles in Figure 19, I put together the cluster's key figures (means of key strategic variables) in Table 14 to get a better "feel" for the data.

Cluster 1 - "Analyzer with prospecting features" – Big Pharma

Cluster 1 is comprised of large, internationally oriented pharmaceuticals with a highly diversified scope of activity. On average, cluster 1 companies deal with roughly seven different therapeutic areas and have the largest (in absolute terms) output of new products. Looking at the actual list of companies, it is obvious that all "big pharma" were captured by this cluster with global players like Pfizer, Sanof-Aventis, GlaxoSmithKline, Merck & Co and AstraZeneca as only some of its prominent members.

In chapter 3.4.6, prospectors were characterized as organizations that move quickly to exploit new opportunities in a relatively broad and changing domain. Also, it is emphasized in Miles and Snow's (1978) framework that prospectors have above average capabilities in marketing and/or R&D and information technology, as their focus lies on identifying opportunities first (first-mover advantage). Analyzers put more focus on efficiency and are described as organizations that carefully consider various options and often chose "second-but-better" strategies over cutting edge technologies (second mover). While the empirically derived cluster-1-solution resembles both analyzers' and prospectors' characteristics, the profiles don't match perfectly. R&D capabilities are clearly quite low with cluster 1 companies and sales/marketing skills are only average. Overall, companies have more in common with analyzers than with prospectors, despite the high number of new products brought to the market. In contrast to my expectation, I didn't find a group of "pure" prospecting companies in the pharmaceutical industry, rather a group of analyzers with some prospecting features that seem to heavily rely on their partners' prospecting capabilities.

	Cluster 1	Cluster 2	Cluster 3
Name	**"Analyzer"**	**"Defender"**	**"Entrepreneur"**
N	**20**	**41**	**28**
employees (thousands)	48,075	2,239	0,363
assets ($mio)	31.004,255	1.088,345	312,154
sales ($mio)	17.630,392	687,551	82,401
r&d ($mio)	2.959,846	101,860	71,566
therap. areas *)	6,8	1,6	1,7
internat. Sales	52,1%	26,3%	11,3%
sales/nda ($mio)	1.380,407	460,304	62,757
sales/employee ($)	391.485,000	431.110,732	195.865,357
sales/assets	61,1%	63,8%	23,4%
nda/thousand empl.	1,2	3,3	1,3
r&d ($ mio)/nda	237,739	66,290	250,481
r&d/sales *)	18,1%	17,5%	129,6%
r&d/employees ($)	68.538,000	80.818,293	229.323,571
r&d/assets	10,1%	11,0%	26,3%
nda*)	12,5	1,5	0,3
nme	3,1	0,3	0,1
nme+bla	4,1	0,3	0,1
nda+bla	13,5	1,6	0,3

Table 14: Cluster profiles – key figures (means).

Cluster 2 – "Defender"

Cluster 2 companies are characterized by remarkably high efficiency rates in both sales and R&D activities, spend very little on R&D and are highly focused in terms of their areas of expertise (with only 1,6 therapeutic areas on average). Interestingly – and not surprisingly – all companies with a strong focus on generics were captured by this category (e.g. Barr Pharmaceuticals, Par Pharmaceutical, Mylan Laboratories, Watson, etc.). Comparing this profile with the description of a defenders's profile (see chapter 3.4.6), it is a very good match.

Cluster 3 – "Entrepreneur"

Finally, I compared cluster 3 features to the description of the entrepreneur in the literature (see chapter 3.4.6). Cluster 3 is characterized by very small companies with a remarkably high commitment to R&D, medium efficiency rates in R&D and low efficiency in sales activities. The low number of new products brought to the market since 2000 might be due to the fact that entrepreneurs are young companies with little experience that yet have to develop their domain.

Obviously they are dependent on external resources and/or partners to further develop their products and services. As suggested by theory, entrepreneurs focus on their core competencies (in this case: R&D) and "sell" their output to partners for commercialization – which explains their low NDA output rate.

H1: Organizations within the same industry may pursue distinctly dissimilar strategies. Organizations with similar strategies within the same industry can be clustered into a limited number of strategic types.

Hypothesis 1 is largely confirmed by the data. While Miles and Snow's framework per se lacks an essential player in this industry, i.e. the entrepreneur, a combination of Miles and Snow's strategic types with Zammuto's framework seems to be a good basis for industry analysis, even in highly dynamic industries. Surprisingly, a group of pure prospectors could not be derived from the empirical analysis. Although the pharmaceutical industry is well-known for its focus on innovation and marketing, big players seem to be rather analyzers with certain prospecting features. Low commitment to R&D and low efficiency in the innovation process point to the fact that these "analyzers" depend highly on external resources, which help them to pursuit new opportunities and finally come up with innovative products. The extent to which pharmaceutical companies rely on partner capabilities to deliver their products and services will be analyzed in detail in the following section.

7 Step 2: Analyzing the strategy – alliance portfolio alignment

The next step is to determine whether the theoretically expected alliance portfolio characteristics are related to the distinct strategic types as described above. To this end, I compared the mean values of alliance portfolio characteristics across clusters. I used a combination of univariate and multivariate techniques comparing network features individually and as a group to test hypotheses 2-5 as described in chapter 3.5. After a brief introduction to the statistical techniques for assessing group differences, the analytical procedure and finally results will be described in detail.

7.1 An introduction to ANOVA and MANOVA

Univariate techniques involve one dependent variable and can be employed to compare two groups (t-test) or more groups (ANOVA = analysis of variance). If, however, two or more dependent variables are to be compared, multivariate techniques offer more reliable results. Hotelling's T^2 is used to compare two groups on several variables and MANOVA (= multivariate analysis of variance) is used to compare multiple groups across multiple dependent variables (Hair, et al., 2006).

When comparing more than two groups, multiple t-tests inflate the overall Type I error rate. ANOVA avoids this problem as it tests whether the entire set of sample means were drawn from the same population. ANOVA offers more flexibility as it is capable of analyzing more than one independent variable at the same time, which is necessary as soon as three groups are to be compared. ANOVA is often viewed as a special case of regression analysis. However, whereas for regression analysis any measurement scales (nominal, ordinal or interval) is permitted for the independent variables, all independent variables must be nominal for ANOVA (Kleinbaum, et al., 1998: 424). As the name implies, ANOVA compares two independent estimates of the variance for the dependent variable. The within-groups estimate of variance (mean square within groups) captures deviations of individual scores from their respective group means and is comparable to the standard error between two means as calculated in t-tests. The between-groups estimate of variance (mean square between groups) is based on the deviations of group means from the overall mean of all scores in the sample and increases if group differences exist. Consequently, the F statistic is calculated as the ratio between the mean square between groups and the mean square within groups, whereby large values of the F statistic lead to rejection of the

null hypothesis (that is, that no differences in means exist across groups). The critical value for the F statistic F_{crit} depends on the required significance level α and results in 2.68, 3.84 and 6.63 for significance levels of .10, .05 and .01, respectively (Hair, et al., 2006: 392).

$$\text{F statistic} = \frac{MS_B}{MS_W}$$

$MS_B =$ mean square between groups

$MS_W =$ mean square within groups

However, the F statistic does not tell which group differs significantly from the others. Therefore, post hoc tests are necessary to explore these differences. An examination of the absolute values of group means will help to draw first conclusions concerning the relative rank of each group with respect to the dependent variable.

Whereas univariate techniques (t test and ANOVA) test for the equality of a single dependent variable across groups, multivariate techniques (Hotelling's T^2 and MANOVA) test for the equality of vectors of means on multiple dependent variables across groups. MANOVA thus handles two variates, one for the dependent (metric) variables and one for the independent (group) variables. Multiple dependent measures are combined by the variate to a single value that maximizes the differences across groups (Anderson, 2003; Hair, et al., 2006). With three or more groups being analyzed, the statistical testing procedure becomes more similar to discriminant analysis. Accordingly, the first variate is termed discriminate function and maximizes the differences between groups by specifying weights for the dependent measures, thereby maximizing the F value, which in turn is used to calculate the greatest characteristic root (gcr) statistic. In the same way as F statistics are compared to the critical F value in ANOVA, the observed gcr value is compared to gcr_{crit} in MANOVA to reject the null hypothesis of equivalent group mean vectors (Harris, 2001). Any subsequent discriminant functions maximize the differences across groups based on the variance not yet explained by the first discriminant function calculated. Typical multivariate tests include e.g. Wilk's Lambda, Pillai's criterion and Hotelling's Trace. Nonwithstanding the similar statistical methods used in forming the variates, MANOVA differs from discriminant analysis primarily in its objectives and the role of the

independent variables. The primary objective of discriminant analysis is to predict the likelihood that an object or individual belongs to a particular group (whereby the set of available groups is prespecified) based on several metric independent variables. On the other hand, MANOVA uses dependent metric variables to compare groups formed by independent non-metric variables, whereby groups are not necessarily prespecified. In this way, MANOVA enables the researcher not only to assess group differences on several dependent variables, but can also shed some light on the question which group characteristics are related to these differences (Hair, et al., 2006: 19, 395, 397). This part of the analysis can, obviously, only be done if more than one independent variable is used to form groups in the first place.

7.2 Analytical procedure

First, I calculated descriptive statistics and inspected the data to see if the normality assumption holds for all variables. Next, I analyzed each network variable individually by using ANOVAs. Finally, I used MANOVA to better control for the overall error inflation.

7.2.1 Descriptive statistics and normality assumption

Descriptive statistics of key alliance network characteristics for the entire sample are displayed in table Table 15. At the time of data collection (approximately June to October 2006), Westaim Corp. and Caraco Pharmaceutical Laboratories did not have any alliances or deals ongoing, which is why their values were counted as “zero” or “missing values” (the latter in cases of divisions by zero). Although Nektar (classified as entrepreneur) and Abraxis (classified as defender) were part of the clustering procedure, they had to be excluded from the analysis due to missing values as unfortunately alliance data could not be collected in these cases. After consideration of missing data, the final sample consisted of 87 companies: 20 analyzers, 40 defenders (including Caraco with zero deals) and 27 entrepreneurs (including Westaim with zero deals).

The number of deals (alliances) entered into by sample companies varies widely between zero and 214 (194). Average tie strength (for calculation details please see Table 11, page 118) varies between 1.5 and 3.25 with a mean value of 2.6. On average, sample companies manage 2.76 acquisitions and 0.29 joint ventures (jv_no).

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Anzahl deals total	87	0	214	32,25	46,607
Anzahl partners total	87	0	177	27,26	37,539
Anzahl alliances (ohne acqu)	87	0	194	29,49	43,155
Anzahl alliance partners (ohne acqu)	87	0	155	24,85	34,361
tiestrength_av	85	1,50	3,25	2,6396	,32525
no acquisitions	87	0	21	2,76	4,267
jv_no	87	0	4	,29	,714
repeated/multiple ties total	85	0	51	5,11	9,769
repeated/multiple ties (ohne acqu)	85	0	48	4,75	9,307
pharmaceutical - big pharma	85	,00	,67	,1292	,14420
pharmaceutical - other	85	,00	1,00	,3585	,21767
biotechnology company	85	,00	,87	,4247	,21601
provider of technologies/research services	85	,00	,33	,0349	,05997
generics manufacturer	85	,00	,40	,0059	,04381
uni	85	,00	1,00	,0327	,11654
medical equipment provider	85	,00	,05	,0024	,00868
ITServices/Business Services	85	,00	,06	,0014	,00742
Other	85	,00	,11	,0054	,01729
in	85	,00	1,00	,5938	,24805
out	85	,00	1,00	,3629	,24447
joint	85	,00	,24	,0426	,06141
repeatedalliances_r	85	,00	,50	,1085	,10155
strongties1_r	85	,00	,50	,1244	,11447
strongties2_r	85	,00	1,00	,5820	,23389
weakties1_r	85	,00	,50	,0724	,10697
weakties2_r	85	,00	1,00	,4180	,23389
acquisitions.deals	85	,00	,44	,0854	,09794
acquisitions.empl	87	,00	50,00	3,2140	7,54032
alliances.empl	87	,00	283,33	31,4934	49,76104
contract_no	87	0	18	1,98	3,379
license_no	87	0	104	12,37	21,299
exlicense_no	87	0	70	11,61	15,158
dealequity_no	87	0	32	3,25	5,095
partnerdiversity	85	,00	,75	,5378	,15120
techdiversity	85	,00	,91	,6227	,25232
Valid N (listwise)	85				

Table 15: Descriptive statistics of alliance portfolio characteristics,German notation of commas.

The partner types are displayed in percentages, i.e. the percentage of total alliances entered into with the respective partner type. For example, on average, roughly one third of all alliances are

built with other pharmaceutical companies and 42% are entered into with biotechnology companies. 60% of all deals are done to obtain skills or resources in exchange for financial compensation ("in") and only 4% can be regarded as joint efforts in a way that resources and skills are contributed equally by both partners. Roughly 10% of all alliances are entered into with prior partners ("repeatedalliances_r"). I operationalized strong ties and weak ties in two different ways (see chapter 5.5.2). "Strong ties_1" was measured as the share of equity alliances in the overall alliance portfolio and ranges from 0% to 50%, with an average of 12.4%. "Strong ties_2" was calculated as the percentage of equity alliances plus exclusive licensing agreements and amounts to roughly 58%. On average, the pharmaceutical companies entered into 31 alliances and 3 acquisitions per thousand employees. Licensing agreements and exclusive licensing agreements account for the large majority of deals in the industry. Technological diversity amounts to .62 and partner diversity reaches .53, on average (Blau's index takes values between 0 and 1).

As the calculation of "partner diversity" is based on the percentages of alliances in all partner categories and some categories were only very sparsely populated, I calculated an alternative measure termed "partner diversity_new" after accumulating values for the following partner categories: generic manufacturers, medical equipment providers, Business/IT services, and others). Neither descriptive statistics nor ANOVA results changed significantly, though, so I stayed with the original measure. I also calculated alternative measures for strong/weak ties and variables relating the number of acquisitions to firm size (employees, sales, assets, etc.). ANOVA test results were extremely robust with regard to these alternative variable calculations.

To check on the normality assumption, I inspected the data visually by using histograms and calculated Kolmogorov-Smirnov tests to complement this analysis with statistical techniques. For the following variables normality can be assumed: tie strength, partner diversity, partner diversity, technological diversity, in (% of deals where resources or skills are obtained in exchange for financial compensation), out (% of deals where resources or skills are provided in exchange for financial compensation), strongties_1, strongties_2, weakties_2, researchalliances_r, alliances/nda and alliances/therapeutic areas.

7.2.2 ANOVA – comparison of individual network characteristics

I used ordinary One-way ANOVA and Kruskal-Wallis (K-W) One-way ANOVA to compare individual alliance portfolio characteristics across all three strategic clusters. K-W ANOVA was used specifically to account for variables where the normality assumption was violated (Diamantopoulos and Schlegelmilch, 2000: 187). ANOVA test results are usually quite robust even in the case of non-normality, but K-W ANOVA was still used to increase the reliability of the results. In almost all cases, the different ANOVAs lead – as expected – to the same results. Both types of ANOVA where calculated by using the SPSS 11.5 for Windows package. Table 16 shows all alliance portfolio measures along the three dimensions (network size, network diversity and tie strength), their significance levels and moreover their mean values for all three strategic types.

The numbers 1, 2 and 3 stand for the respective clusters (1= analyzer, 2=defender, 3= entrepreneur). Columns 'N' and 'H' indicate whether normality and homogeneity-of-variances assumptions can be confirmed. Whenever this was not the case, significances are reported for K-W ANOVA results. Generally, there were only minor differences between the two ANOVA versions with respect to the specific significance level. Results turned out to be somewhat contradictory only once, i.e. for therapeutic areas, where only K-W results were significant. Mean values give some first insight into the relative ranks of clusters with respect to the alliance portfolio measures. The significance level indicates whether at least one group differs significantly to at least one other group. More precisely, ANOVA calculates F-statistics and compares them to critical F-values at the associated significance levels. A significance level of e.g. $\alpha = .05$ means that we can conclude that the groups exhibit differences in group means on the dependent variable with a Type I error probability of α. Post-hoc tests perform pair-wise comparisons of groups and point out which groups exactly differ from each other. The green color indicates significant differences while the darker red color shows us that group differences cannot be assumed at a reasonable error probability ($p \leq .05$).

Network size was operationalized by the number of alliances and the number of alliance partners (relative to firm size) in the alliance portfolio (see chapter 5.5.2). All variables were highly significant. Entrepreneurs turned out to have the largest network relative to their size and "big pharma" (analyzers) ranked last. Obviously, in absolute terms, cluster 1 companies entered into most alliances on average (see Table 17).

						mean values			post-hoc		
dim.	variable name	variable description	N	H	sign	1	2	3	1:2	1:3	2:3
nw size	alliances.empl	alliances rel. to size (thousand empl)			.000	5,83	29,08	54,08			
	alliances.sales	alliances rel. to size (sales)			.000	0,01	0,07	0,28			
	alliancepartners.sales	alliancepartners (rel.)			.000	0,01	0,06	0,24			
	alliancepartners.empl	alliancepartners (rel.)			.000	5,13	26,26	46,43			
diversity	techdiversity	technological diversity (Blau's index)	ok		.000	0,83	0,61	0,48			
	partnerdiversity	partner type diversity (Blau's index)	ok	ok	.349	0,55	0,51	0,57			
tie strength	tiestrength_av	Av. tie strength; arithmetic av. of alliance codes (values	ok	ok	.183	2,61	2,59	2,74			
	repeatedalliances_no	repeated or multiple ties			.000	16,10	1,23	1,31			
	repeatedalliances_r	repeated or multiple ties (as % of total number of alliances)			.002	0,16	0,09	0,09			
	strongties1_r	"strong" defined as jv or equity alliance, as % of total alliances	ok		.748	0,12	0,12	0,13			
	strongties2_r	"strong" defined as jv, equity alliance or exclusive licensing, as % of total alliances	ok	ok	.472	0,55	0,57	0,63			
	weakties1_r	"weak" = contractual agreement or product acquisition; as % of total alliances			.000	0,06	0,11	0,02			
	weakties2_r	"weak" = contractual agreement, product acquisition or simple licensing, as % of total alliances	ok	ok	.472	0,45	0,43	0,37			
	acquisitions_no	acquisitions			.000	6,75	1,83	1,19			
	acquisitions.sales	acquisitions rel. to firm size (sales)			.754	0,02	0,07	0,25			
	acquisitions.empl	acquisitions rel to size (thousand empl.)			.584	0,69	2,94	5,49			

Table 16: ANOVA results (N=normality assumption; H= homogeneity of variances).

Network diversity was captured by two different indices, i.e. a partner diversity index (based on the mix of partner types in the portfolio) and a technology index (based on the mix of product therapeutic areas in the alliance deals). Whereas the partner index was not significant at all, technological diversity differed significantly across clusters, with big pharma having the most diversified alliance portfolio with respect to the variety of products produced and services provided together with alliance partners.

In contrast to the first two dimensions described below, variables measuring tie strength were hardly significant. Where results were significant, they contradicted hypotheses as stated in chapter 3.5. While hypothesis 5 proposes that defenders and entrepreneurs should have, on average, stronger ties than other strategic types, Big pharma scored highest on the variable "repeated ties" and quite low on "weak ties". The disappointingly low significance levels might be due to lower practical significance of the measures and/or to inappropriate operationalizations of the underlying constructs. The strength of a tie, i.e. the level of mutual commitment, dependence and trust in a relationship is obviously hard to capture by secondary data. The average tie strength in the portfolios of cluster companies[37] hardly differs across strategic groups. Additionally, two versions of "strong ties" and "weak ties", respectively, were calculated (see Table 16 for a description of those variables). "Weak ties 1" represents simple contractual agreements and product acquisitions only, i.e. those alliances with no equity involvement and agreements of short duration (no licensing contracts, rather transaction-oriented). In contrast to expectations, big pharma had significantly less weak ties than the other strategic groups. In line with these interesting results, they scored highest on "repeated ties_r", a variable that captures the relative share of repeated relationships in all relationships managed. Despite the fact that analyzers have to handle a huge network of relationships, commitment is still emphasized and there is a tendency to prolong deals and/or enter into multiple relationships with the same partner over time. This empirical finding is in line with previous studies that have found a positive relationship between alliance experience and the probability of entering into new alliances (Ahuja, 2000b; Gulati, 1999; Gulati and Gargiulo, 1999). The tendency to increase commitment in alliance deals might also be due to the financial strength of the companies and their desire to control the partnerships. Simple contractual agreements and product acquisitions minimize risk but at the same time offer less access to resources and strategic opportunities.

[37] Tie strength was measured by using a scale (1-5) to classify each alliance according to its strength (see chapter 5.5.2) and then calculating the "average tie strength" for each portfolio. Cluster means represent the means of those average portfolio values.

						mean values			post-hoc		
dim.	variable name	variable description	n	h	sign	1	2	3	1:2	1:3	2:3
other variables	alliances_no	number of alliances			.000	88,95	11,95	11,44			
	alliancepartners_no	number of alliance partners			.000	72,85	10,75	10,19			
	R	% of alliances where research is involved	ok	ok	.002	0,44	0,22	0,37			
	D	% of alliances where development is involved	ok	ok	.002	0,72	0,53	0,69			
	Mf	% of alliances where manufacturing is involved	ok	ok	.468	0,30	0,38	0,32			
	MS	% of alliances where marketing and/or sales services are involved		ok	.017	0,92	0,94	0,97			
	in	% of "in" alliances (resources / skills obtained from partners)	ok		.014	0,67	0,64	0,46			
	out	% of "out" alliances (resources / skills provided to partners)	ok		.008	0,27	0,32	0,49			
	joint	% of "joint" alliances (resources/skills shared by both partners equally)			.059	0,05	0,04	0,04			
	researchalliances_r	% of deals with research partner (uni, provider of reserach services or biotech company)	ok	ok	.001	0,64	0,42	0,48			

Table 17: ANOVA results on other relevant alliance portfolio characteristics.

In addition to the alliance portfolio variables as derived from the literature I, also compared the clusters along other relevant network characteristics as displayed in Table 17. Cluster 1 invests most in R&D alliances and shows the largest share of "in"-partnerships where they obtains resources and/or skills. As expected, entrepreneurs focus on "out" relationships and offer their skills and services in return for financial compensation. Defenders score lowest on the variable "researchalliances_r" which calculates the share of research partners (universities, research laboratories, biotechnology companies and other research service providers) in the total alliance portfolio. Although this was not part of hypotheses testing, findings support the typical profile of defenders as suggested by literature (less focus on innovation in exchange for higher efficiency).

7.2.3 MANOVA – comparison of profiles

Broadly speaking, MANOVA complements ANOVA in that it enables the researcher to compare multiple dependent variables simultaneously. Hair (2006: 401) highlights two specific motives for using MANOVA, namely i) to control for the experiment-wide error rate and ii) to test for differences among a combination of dependent variables. Even if dependent variables are analyzed only separately, a series of separate t-tests of ANOVAs cannot control the effective overall Type I error rate, which increases if several variables are uncorrelated. Moreover, MANOVA is able to capture correlations among the dependent variables and can therefore

identify their collective effect and my provide dimensions of differences that distinguish groups even better than individual dependent variables.

However, MANOVA also bears certain challenges as – compared to ANOVA – even more preconditions have to be met before analyses can be performed. First, the selection of dependent variables becomes more critical as they interact in the analysis. While MANOVA enables the researcher to analyze several variables at the same time, the number of variables is strongly limited by sample size requirements (Läuter, 1978). As an example, for medium to large effect sizes a sample size of 30-40 objects per group is required for three dependent variables to achieve statistical power of .80. Other important prerequisites include i) detection of outliers, ii) independence among observations, iii) equality of variance-covariance matrices and iv) normality. The independence requirement is clearly met in this case. The equality of variance-covariance matrices can be tested by applying the Box's M test. Moderate violations are not a problem as long as groups are of approximately equal size (which is the case for at least big pharma and entrepreneurs in my sample). As the Box's M test is sensitive to violations of the normality assumption, at least univariate normality should be found in the dependent variables. Moreover, the dependent measures should not have high multicollinearity (Hair, et al., 2006).

Selection of dependent variables

Given all these preconditions and limitation, I decided to include a maximum of three to four dependent variables in the analysis. I used cluster identity (levels 1-3) as independent variable (i.e. factor or treatment). Although the inclusion of several independent strategic firm-level variables (e.g. sales, R&D-to-sales ratio, number of therapeutic areas, etc.) would be an interesting variation of the analysis, this would clearly go beyond the scope of this research project. Due to their theoretical importance and their significance in ANOVA, I considered the following variables for MANOVA:

- number of alliances (relative to sales)
- technological diversity (Blau's heterogeneity index)
- weak ties (% of contractual agreements and product acquisitions in total alliances)
- repeated ties (% of repeated alliances in total alliances)

Normality assumption, correlations and outliers

As already discussed in chapter 7.2.2, normal distribution cannot be assumed for most of the variables. Specifically, out of the above mentioned variables, only technological diversity is considered to meet this requirement. The results of correlation analysis are displayed in Table 18. As correlations are generally rather low, multicollinearity among dependent variables is not assumed. I checked all variables for outliers by using box plot diagrams and identified several cases for the following variables: repeated alliances (Columbia Laboratories), alliances/sales (Vernalis, Isis Pharmaceuticals, Questcor Pharmaceuticals, Immunogen), technological diversity (Taro, Pozen, Vivus, Inspire Pharmaceuticals) and alliances/sales (Questcor Pharmaceuticals, Vernalis, Pozen, Columbia, Isis, Immunogen). Outliers identified were mostly from the cluster "entrepreneur" and are due to some variation in firm size. However, as MANOVA results were not sensitive to the exclusion of the above mentioned cases, I decided not to eliminate them from the data.

Correlations

			alliances.sales	techdiversity	repeatedalliances_r	weakties1_r
Spearman's rho	alliances.sales	Correlation Coefficient	1,000	-,525**	-,194	-,329**
		Sig. (2-tailed)	.	,000	,075	,002
		N	87	85	85	85
	techdiversity	Correlation Coefficient	-,525**	1,000	,313**	,197
		Sig. (2-tailed)	,000	.	,004	,071
		N	85	85	85	85
	repeatedalliances_r	Correlation Coefficient	-,194	,313**	1,000	,092
		Sig. (2-tailed)	,075	,004	.	,403
		N	85	85	85	85
	weakties1_r	Correlation Coefficient	-,329**	,197	,092	1,000
		Sig. (2-tailed)	,002	,071	,403	.
		N	85	85	85	85

**. Correlation is significant at the 0.01 level (2-tailed).

Table 18: Correlations of variables used in MANOVA..

Significance testing and post-hoc tests

Software packages typically offer a variety of statistical measures to asses the differences across dimensions of the dependent variables. SPSS 15.2 for Windows calculates Wilks' Lambda, Hotelling's Trace, Roy's Largest Root and Pillai's Trace, whereby the latter is considered to be specifically robust if sample size is small, cell sizes are unequal or the homogeneity-of-covariances assumption is violated (Hair, et al., 2006: 414). Table 19 displays the overall model

results. As usually is the case, all statistical measures provide the same result – in this case they confirm that the chosen dependent variables differ significantly across clusters.

Multivariate Tests[d]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	Pillai's Trace	,918	220,426[b]	4,000	79,000	,000	,918	881,702	1,000
	Wilks' Lambda	,082	220,426[b]	4,000	79,000	,000	,918	881,702	1,000
	Hotelling's Trace	11,161	220,426[b]	4,000	79,000	,000	,918	881,702	1,000
	Roy's Largest Root	11,161	220,426[b]	4,000	79,000	,000	,918	881,702	1,000
cluster	Pillai's Trace	,678	10,248	8,000	160,000	,000	,339	81,988	1,000
	Wilks' Lambda	,392	11,780[b]	8,000	158,000	,000	,374	94,244	1,000
	Hotelling's Trace	1,370	13,361	8,000	156,000	,000	,407	106,892	1,000
	Roy's Largest Root	1,225	24,496[c]	4,000	80,000	,000	,551	97,984	1,000

a. Computed using alpha = ,05

b. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

d. Design: Intercept+cluster

Table 19: MANOVA - multivariate tests.

In the next step, I examined each network variable separately across different clusters. Table 20 summarizes univariate test statistics which examine every effect in the model separately (as listed in the left column under "source"). According to these statistics, cluster membership has a highly significant effect on all dependent variables with significance levels between .000 and .018. Another issue of primary concern in MANOVA is the observed power level. Power is the probability that statistical testing will identify an effect if it actually exists and can be regarded as the "sensitivity" of a test (Hair, et al., 2006: 414). Power is calculated as $(1-\beta)$, i.e. one minus the probability of Type II error. Power is driven by i) the alpha-level, ii) the effect size of the treatment and iii) sample size. While setting the alpha-level low (e.g. at .01) decreases the probability of wrongly rejecting the null hypothesis, a low beta increases the chances that an effect will be found if it is actually there. Ceteris paribus, larger effect sizes and larger samples increase the power of a test.

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Noncent. Parameter	Observed Power[a]
Corrected Model	alliances.sales	1,037[b]	2	,519	17,529	,000	35,058	1,000
	techdiversity	1,353[c]	2	,676	13,885	,000	27,770	,998
	repeatedalliances_r	,080[d]	2	,040	4,193	,018	8,386	,722
	weakties1_r	,112[e]	2	,056	5,433	,006	10,865	,834
Intercept	alliances.sales	1,246	1	1,246	42,119	,000	42,119	1,000
	techdiversity	32,319	1	32,319	663,363	,000	663,363	1,000
	repeatedalliances_r	1,052	1	1,052	109,803	,000	109,803	1,000
	weakties1_r	,342	1	,342	32,996	,000	32,996	1,000
cluster	alliances.sales	1,037	2	,519	17,529	,000	35,058	1,000
	techdiversity	1,353	2	,676	13,885	,000	27,770	,998
	repeatedalliances_r	,080	2	,040	4,193	,018	8,386	,722
	weakties1_r	,112	2	,056	5,433	,006	10,865	,834
Error	alliances.sales	2,427	82	,030				
	techdiversity	3,995	82	,049				
	repeatedalliances_r	,786	82	,010				
	weakties1_r	,849	82	,010				
Total	alliances.sales	4,805	85					
	techdiversity	38,308	85					
	repeatedalliances_r	1,866	85					
	weakties1_r	1,407	85					
Corrected Total	alliances.sales	3,464	84					
	techdiversity	5,348	84					
	repeatedalliances_r	,866	84					
	weakties1_r	,961	84					

a. Computed using alpha = ,05

b. R Squared = ,299 (Adjusted R Squared = ,282)

c. R Squared = ,253 (Adjusted R Squared = ,235)

d. R Squared = ,093 (Adjusted R Squared = ,071)

e. R Squared = ,117 (Adjusted R Squared = ,095)

Table 20: MANOVA – univeriate tests (between-subject effects).

Läuter (1978) suggests a required power level of at least .8. In the present analysis, the observed power level for multivariate testing is 1.000 and meets this requirement. For the univariate tests as displayed in Table 20, only the variable "repeated alliances" scores slightly below this benchmark at .722. Overall, however, univariate results confirm hypotheses with high significance levels and acceptable to high power levels and R^2 levels.

In post-hoc tests – similar to ANOVA analysis – I used Scheffé and Bonferroni methods as well as Tamhane and Dunette T3 for non-parametric variables (all except technological diversity in this case). Post-hoc tests in MANOVA largely confirmed ANOVA results as already displayed in Table 16 on page 145:

- "Technological diversity" differs significantly between Big Pharma and Defenders as well as between Big Pharma and Entrepreneurs.

- The variable “repeated alliances” differs significantly between Big Pharma and Defenders as well as between Big Pharma and Entrepreneurs.
- “Weak ties” differs only between Defenders and Entrepreneurs.
- “Alliances/sales” differs even between all three distinct strategic types.

Limitations and suggestions for further multivariate analyses

Overall, MANOVA results are consistent with ANOVA analyses and largely confirm that significant differences in alliance portfolio characteristics exist across distinct strategic types. However, MANOVA results are limited as they only assess the differences in three network variables. Further research should include more variables into multivariate analysis to derive consistent alliance portfolio profiles that differ across clusters. The inclusion of multiple dependent variables is, however, limited by sample size and effect sizes.

Results are also limited by the fact that most of the variables are not normally distributed and equality of variance tests were significant (Box’s M test of equality of covariance matrices and Levene’s test of equality). Although a violation of these equality-of-variance assumptions is considered to have only minimal impacts if effect sizes are large and group sizes are roughly equal (Hair, et al., 2006), problems might arise if more dependent variables are analysed simultaneously.

Finally it must be said that MANOVA results as presented above are only a first step towards multivariate analysis of alliance portfolio characteristics and that the full potential of MANOVA goes far beyond the present initial analysis. Future attempts should not only aim at including more dependent variables (that is, network characteristics) but could also explore multiple independent variables to shed further light on the relationship between strategic variables and network variables. In the above analysis, cluster analysis was performed first and the derived cluster solution was taken as given for the consecutive comparison of cluster means. An alternative approach would be to use the clustering variables directly in MANOVA to better exploit its potential and obtain richer data concerning the drivers of network characteristics (i.e. which strategic characteristic is responsible for which alliance portfolio feature).

7.3 Summary of results

The above analysis indicates that different strategies exist in the pharmaceutical industry and that alliance portfolio characteristics vary across strategic types. In the following, hypotheses 2-6 (as presented in chapter 3.5 and summarized in Figure 8) will be discussed in detail.

Hypothesis 2: Alliance portfolio characteristics will vary significantly across strategic types; largely supported (as will be shown in the discussion of hypothesis 3-6).

Hypothesis 3 a/b/c/d: Prospectors and entrepreneurs will have larger networks (relative to their size) than defenders and analyzers; partially supported.

I argued that alliance portfolio size highly influenced the quantity of resources accessed by the focal company. Central firms are in an advantageous position because they are less dependent on individual sources of supply, more flexible, and can exploit opportunities faster than competitors. Previous research has specifically highlighted the positive effects of network size on innovation output. Consequently, I proposed that firms that are highly dependent on the early pursuit of new opportunities and novel technologies should have more strategic alliances (on average) than companies following more efficiency-oriented strategies. Results of both ANOVA and MANOVA largely confirmed the hypothesis. As displayed on Table 16 (page 145), entrepreneurs had a significantly higher number of alliances and alliance partners than their peers. In absolute numbers, naturally, analyzers ranked first with an average of 89 alliances per firm. Empirical analysis also found that there are differences between defenders' and analyzers' networks: relative to their size (in terms of employees and sales), defenders had larger networks than analyzers. Given the fact that analyzers have "prospecting features" in this study, propositions would have suggested that they manage more alliance than their defending peers. In this aspect, results are somewhat surprising and highlight the huge impact of firm size on (relative) network size.

Overall, empirical results indicate that network size is not only a function of a firm's orientation towards change, but also highly dependent on the company's size and thus the amount of internal resources accessible. While the number of alliances and partners in absolute terms increases with firm size, relative network size decreases for larger companies. Regression analyses could give even more insight into these relationships in the future.

Hypothesis 4 a/b/c/d: Prospectors and analyzers will have, on average, more diverse networks than defenders and entrepreneurs; largely supported.

Literature suggests that the mere accumulation of alliances increases costs but doesn't necessarily increase benefits as redundant ties are added to the network. Diverse networks are better capable of providing access to truly novel resources and boost innovation output. However, diversity is hard to manage and comes only at a certain cost. Consequently, I proposed that only large firms will be able to "afford" a diverse alliance portfolio. Network diversity was operationalized by "partner diversity" and "technological diversity" (see chapter 5.5.2 for a detailed description of measures). While partner diversity did not deliver any significant results, technological diversity was highly significant ($p<.001$). As expected, big pharma (analyzers with prospecting features) scored highest on this portfolio characteristic. Obviously, technological diversity requires a minimum of internal skills in the respective areas – a requirement that can only be met by rather large, diversified players. The heterogeneity in alliance partners was roughly equal in all three clusters and indicates that partner type choice is primarily a matter of one's own identity and the specific purpose of the alliance, but not the overall strategic orientation of the firm.

Hypothesis 5 *a/b/c/d: Defenders and entrepreneurs will have, on average, stronger ties than prospectors and analyzers; largely rejected.*

Strong ties are embedded in a rich social context and are characterized by high commitment of both alliance partners. Theory suggests that strong (embedded) ties are advantageous as they allow for joint problem solving and fine-grained information transfer. I proposed that companies with a more focused business scope will have, relative to others, stronger ties as they are better able to commit resources to their core areas. Average tie strength (as measured by Blau's heterogeneity index) didn't show any significant differences across clusters. Interestingly enough, however, big pharma ranked highest on "repeated ties" (as a percentage of all alliances), which indicates that cluster 1 members have a tendency to enter into multiple and/or repeated alliances with their partners. Moreover, defenders scored highest on "weak ties". To sum up, these results indicate quite the opposite of what was stated in the hypotheses. The tendency of companies to enter into repeat partnerships seems to depend highly on their overall alliance experience and network size. This is in line with a stream of literature arguing that alliance formation is driven by the existing network relationships (Ahuja, 2000b; Gulati, 1999; Gulati and Gargiulo, 1999). The fact that analyzers ranked low on weak ties might be due to their financial strength and their proclivity to enter into licensing agreements and/or equity-based alliances.

Entrepreneurs differed significantly form defenders and scored lowest on “weak ties”. This result is in line with the proposition that focused companies prefer stronger relationships.

Overall, results suggest that tie strength (i.e. the partners’ commitment to the relationship) depends highly on their own capacity to mobilize (financial) internal resources. Moreover, the data indicate that R&D-focused companies hardly enter into simple contractual agreement at all, but prefer stronger ties instead. Put differently, tie strength is thus dependent on both the amount of firm resources and experiences available and the firm’s orientation towards change and innovation.

Hypothesis 6: Overall, alliance portfolio profiles will differ across strategic types; largely supported.

In addition to the differences in individual alliance portfolio characteristics, I expected to find distinct alliance patterns depending on the strategic orientation. MANOVA results largely support the proposed relationships as confirmed in Table 20. Network characteristics (as measured by network size, technological diversity, repeated ties and the mix of strong/weak ties) vary collectively across strategic types. These findings represent only first results and suggest further exploration of alliance portfolio profiles in future research.

8 Discussion

The purpose of this final discussion is to assess the results of the present empirical study in the light of previous research in the field and to position the major findings within the larger context of strategy and alliance research. More specifically, I will discuss this study with respect to its contribution to i) strategy research and strategic types in particular, ii) the study of alliance portfolios iii) research on the positive effect of networks and certain network characteristics on firm output variables.

Contribution to strategy research

The identification of a limited number of successful strategies or "strategic types" has been at the core of strategy research since its early days. While some have focused on sophisticated empirical techniques to derive clusters in a given industry by using objective indicators (often accounting or market data) (e.g. Caves and Porter, 1977; Cool and Schendel, 1987), others have successfully developed strategic typologies based on a mix of theory and theory-based empirical studies (Miles and Snow, 1978; Porter, 1979; Zammuto, 1988). The operationalization of strategy is arguably the most difficult issue in the field and authors have used a wide array of methods, ranging from investigator inference and textual descriptions to Likert-type scales and quantitative secondary data (mostly accounting data) (see Conant, et al., 1990: for a good overview).

The purpose of this study was to empirically derive clusters of organizations with similar strategies and to compare them to existing typologies. I decided to measure strategy by using objective indicators, i.e. quantitative secondary data which I collected mostly from databases and annual reports. The clusters derived (chapter 6.3.1) exhibit convincingly clear-cut profiles and therefore confirm the usefulness of objective indicators for measuring strategy. In fact, only three key strategic variables were used in the clustering procedure as they discriminated well among the groups. Although the identification of key strategic variables for a given industry is difficult, once identified, they can deliver objective results that are relatively easy to interpret.

Miles and Snow's (1978) traditional typology of defenders, prospectors and analyzers was only partially confirmed by empirical findings in the pharmaceutical industry. In contrast to expectations, a pure group of prospectors could not be found in the data, despite of the industry's

emphasis on research and development. Interestingly enough, some industry experts[38] mentioned that "almost everybody" was an analyzer today. In this aspect, practitioner's intuition fits well empirical findings. A closer look at the data confirmed that the identified group of "analyzers with prospecting features" showed only low commitment to R&D and low productivity rates with regard to the commercialization of new, innovative products. The cluster was classified as "analyzers" due to companies' size, scope of operations and marketing efficiency. Another disadvantage of Miles and Snow's typology is the lack of an "entrepreneur" strategic type. I used Zammuto's framework (1988) which combines Miles and Snow's typology with organizational ecology perspectives (see 3.4.5) and builds on two basic strategy dimensions, i.e. scope of operations and "logic" of profit generation (efficiency versus new opportunities). Zammuto's framework also includes "entrepreneurs", which turned out to be a major cluster in the pharmaceutical industry. The profile of "defenders", finally, matched the theoretical profile well.

Whereas traditional strategic typologies are typically based on the dimensions "scope of business" and "logic of rent generation" or "orientation towards change", empirical findings suggest that a third dimension should be added: the extent of vertical integration - or the ability (inability) of the company to deliver its products and services through internal resources, as opposed to drawing largely on external partners. At this point, business strategy and alliance are strongly interdependent and difficult to disentangle. The question is not only *what* a company offers (focused versus diversified product range), but also *how* the company obtains the required resources to deliver its products. The typical prospector (a large, diversified and innovation-focused company) seems to make room for analyzer-organizations that are just as large and diversified but outsource many activities along the value-chain, above all R&D activities. In a dynamic industry, innovators obviously either have to be small and young (e.g. high-tech start-up company) or big and highly networked (e.g. Royal Philips Electronics), with a decentralized business organization and a huge network of competent partners.

Contribution to the study of alliance portfolios

While many authors have emphasized the necessity to study the entire network of a company's relationships (in contrast to individual alliances), only few studies have tried to better understand or even operationalize the complex construct "alliance portfolio" (e.g. Gulati, 1999; e.g. Hoffmann, 2005; Koka and Prescott, 2002).

[38] See summary of interviews with industry experts in Appendix 1.

The present study shows that a company's alliance portfolio (characterized by the number of alliances, the diversity of alliances and the average strength of alliance relationships) represents the overall, implemented alliance strategy. Traditional strategic decisions (e.g. product-market decisions, level of differentiation, etc.) should be complemented by considerations concerning the configuration of the alliance portfolio.

I operationalized the alliance portfolio construct by drawing on previous studies and identified three major dimensions represented by several key variables each. This study goes beyond existing research as it tests hypotheses considering alliance portfolio characteristics in a quantitative empirical study. Data on over 2800 deals of roughly 90 pharmaceutical companies were collected and analyzed on the alliance portfolio level (i.e. from the focal firm's perspective). This approach offers the opportunity to analyze alliance portfolio configuration as part of the organizations' overall business strategy and sheds some light on the complex relationship between business strategy and alliance formation.

Contribution to research on positive effects of networks

A huge stream of literature has emerged around the question of the "optimal" network. Social network scholars have discussed the concept of structural and relational embeddedness of a firm, but studies have, so far, offered contradictory results. The most prominent example of contradictory findings is arguably the controversy between Burt's (1992) "weak ties" argument and Coleman's (1990) promotion of social capital and strong ties. More recently, studies have increasingly argued for a contingency-based view on the network – performance relationship. Contingency factors used in previous studies include market conditions (Gulati and Higgins 2003), firm nationality (Koka and Prescott 2002), organizational structure (Geletkanycz, Boyd and Finkelstein 2001), growth stage (Hite and Hesterley 2001) and industry dynamics (Rowley et al. 2000). This study introduces a company's strategic orientation as main determinant of the actual alliance portfolio configuration. Not only structural or relational effects (as proposed by social network theory), but also resource-based arguments play a major role when describing the alignment of strategic needs and alliance portfolio design.

9 Conclusion and implications for future research

The present study has shed some light on the complex interplay between a company's strategic orientation and the configuration of its alliance portfolio. The study focused on a single industry (the pharmaceutical industry) to control for industry effects and to ensure that sample companies face a similar environment. Organizations can be classified into distinct strategic groups that differ not only with respect to key strategic variables but also regarding the configuration of their alliance portfolios. The main findings can be summarized as follows:

- Analyzers manage large portfolios of alliances in absolute terms, however small ones if related to firm size. Network diversity is very high, as well as average tie strength.
- Defenders have medium-to-small networks with rather weak ties. The share of strong ties is similar to entrepreneurs' profile and much lower than for analyzers.
- Entrepreneurs have a relatively large and highly focused network. Moreover, their relationships are rather strong compared to defenders, but not as strong as analyzers' relationships.

Based on these findings and the discussion above, several topics for further research are suggested. Obviously, more industries should be studied to see if other industries follow a similar typology as discussed in this study or rather match more traditional typologies. Moreover, as key strategic variables are industry-specific, it would be interesting to see if the analysis of the strategy – alliance relationship offers similar results in other industries.

Future research should also further explore the construct "alliance portfolio" and possibly assess different operationalizations of network characteristics (e.g. tie strength, diversity, etc.) Moreover, it would be interesting to focus a little more on the resource-based view and analyze the specific role an alliance has in the overall business strategy context. Are alliances used to enforce competencies or rather to compensate for the lack of skills in a specific are? Although results of the present study indicate the latter, this issue should be dealt with in greater detail.

MANOVA (= multivariate analysis of variance) could be used to a much greater extent to explore strategy – alliance portfolio relationships. So far, the analysis has largely focused on the comparison of individual network characteristics and not so much on the overall alliance portfolio profiles.

Finally, the next step should be to analyze the match – performance relationship. This can be done by defining an “ideal” profile per strategic type, and then comparing each case in a cluster to this profile. This way, distances can be calculated, which are subsequently related to firm-level performance indicators.

Appendices

Appendix 1: Summary of interviews with pharmaceutical managers

Explorative and confirmative interviews with industry experts were conducted from June 11, 2006 to June 16, 2006 during the Wharton-Windhover Program for Pharmaceutical and Biotech Executives. Apart from several informal meetings, three structured interviews were conducted to i) deepen my industry-knowledge and get a better feeling for trends and developments within the pharmaceutical industry, ii) to get an assessment of the usefulness of the theoretical strategic typologies used as a basis for cluster analysis, and iii) to collect feedback and constructive critique on the alliance type and partner type classification schemes used for coding the alliance data.

Miles and Snow's (1978) was regarded as partially useful, as interviewees mentioned that too many companies might fall under the middle "analyzer" category. "To some extent, everybody is an analyzer…" as one of the interviewees put it. Zammuto's (1988) framework was ever better accepted and was regarded as a "reasonable" classification scheme for the industry. Typically, speciality pharmaceuticals and generics manufacturers should be categorized as defenders, generics and also big pharma might be analyzers, big pharma might be prospectors, and biotechs should be entrepreneurs[39]. While the "role" of a company used to be clear-cut until only a few years ago, boundaries between categories of pharma companies have started to blur. Interviewees often mentioned that there is a tendency among big pharma (traditionally prospectors) to move towards the corner of analyzers. On the other hand, specialized companies continuously enlarge their product portfolios – stretching towards an analyzer profile, too. "Even big pharmaceutical companies need to focus more and more on cost efficiency", as an interviewee put it.

The partner type and alliance type classification schemes were discussed and complemented by the interviewees. The results are displayed in chapter 5.5.2.

Appendix 2:

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
therareas	1	20	6,80	2,262	,506	5,74	7,86	3	10
	2	41	1,59	1,024	,160	1,26	1,91	0	3
	3	28	1,71	1,117	,211	1,28	2,15	0	4
	Total	89	2,80	2,581	,274	2,25	3,34	0	10
salesint_ant	1	20	,5210	,27560	,06163	,3920	,6500	,04	,98
	2	41	,2627	,37298	,05825	,1450	,3804	,00	,99
	3	28	,1129	,24329	,04598	,0185	,2072	,00	,95
	Total	89	,2736	,34638	,03672	,2006	,3466	,00	,99
av_empl	1	20	48,0750	37,64332	8,41730	30,4574	65,6926	,41	114,33
	2	41	2,2393	4,24413	,66282	,8997	3,5789	,04	19,52
	3	28	,3625	,43659	,08251	,1932	,5318	,03	2,24
	Total	89	11,9490	26,40918	2,79937	6,3858	17,5121	,03	114,33
av_assets	1	20	31004,26	29682,09923	6637,119	17112,6049	44895,9051	950,57	119341,3
	2	41	1088,3454	1762,95206	275,32686	531,8890	1644,8017	27,48	8645,10
	3	28	312,1543	474,92807	89,75297	127,9964	496,3122	53,83	2547,01
	Total	89	7566,8267	18784,25095	1991,127	3609,8810	11523,7725	27,48	119341,3
av_sales	1	20	17630,39	14922,91034	3336,864	10646,2550	24614,5290	147,77	49667,33
	2	41	687,5515	1184,82119	185,03798	313,5758	1061,5272	15,71	5122,94
	3	28	82,4011	181,02424	34,21037	12,2072	152,5949	10,61	980,71
	Total	89	4304,5470	10042,69461	1064,523	2189,0302	6420,0637	10,61	49667,33
av_rd	1	20	2959,8460	2702,77442	604,35873	1694,9086	4224,7834	58,98	10010,67
	2	41	101,8605	170,15392	26,57358	48,1533	155,5677	,00	769,45
	3	28	71,5661	84,27831	15,92710	38,8864	104,2458	14,47	435,16
	Total	89	734,5736	1744,80720	184,94919	367,0259	1102,1213	,00	10010,67
sales.empl	1	20	391,4850	97,46547	21,79394	345,8698	437,1002	259,81	622,75
	2	41	431,1107	274,17316	42,81865	344,5710	517,6505	73,97	1350,05
	3	28	195,8654	113,05527	21,36544	152,0271	239,7036	62,66	538,37
	Total	89	348,1963	226,17133	23,97411	300,5528	395,8398	62,66	1350,05
sales.assets	1	20	,6105	,21370	,04779	,5105	,7105	,16	,92
	2	41	,6383	,27041	,04223	,5529	,7236	,24	1,52
	3	28	,2336	,10339	,01954	,1935	,2737	,10	,47
	Total	89	,5047	,28395	,03010	,4449	,5645	,10	1,52
rd.sales	1	20	,1805	,07844	,01754	,1438	,2172	,09	,40
	2	41	,1751	,12339	,01927	,1362	,2141	,00	,42
	3	28	1,2961	,55354	,10461	1,0814	1,5107	,44	2,83
	Total	89	,5290	,61272	,06495	,3999	,6581	,00	2,83
rd.empl	1	20	68,5380	26,98643	6,03435	55,9080	81,1680	29,34	142,59
	2	41	80,8183	78,58644	12,27314	56,0134	105,6232	,00	306,98
	3	28	229,3236	111,34367	21,04198	186,1490	272,4981	78,19	476,43
	Total	89	124,7794	108,92677	11,54621	101,8338	147,7251	,00	476,43
rd.assets	1	20	,1009	,03865	,00864	,0828	,1190	,06	,22
	2	41	,1098	,09865	,01541	,0787	,1410	,00	,56
	3	28	,2630	,07466	,01411	,2341	,2920	,15	,44
	Total	89	,1560	,10856	,01151	,1331	,1789	,00	,56
nda00	1	20	12,45	9,372	2,096	8,06	16,84	0	40
	2	41	1,54	1,306	,204	1,12	1,95	0	4
	3	28	,29	,535	,101	,08	,49	0	2
	Total	89	3,60	6,566	,696	2,21	4,98	0	40
nme00	1	20	3,10	3,227	,721	1,59	4,61	0	12
	2	41	,32	,610	,095	,12	,51	0	2
	3	28	,14	,448	,085	-,03	,32	0	2
	Total	89	,89	1,980	,210	,47	1,30	0	12
nda00.empl	1	20	1,2310	3,25362	,72753	-,2917	2,7537	,00	14,6
	2	41	3,3484	5,62430	,87837	1,5732	5,1237	,00	23,5
	3	28	1,3028	2,84680	,53800	,1990	2,4067	,00	10,0
	Total	89	2,2290	4,49820	,47681	1,2815	3,1766	,00	23,5
nda00.assets	1	20	,0011	,00160	,00036	,0003	,0018	,00	,01
	2	41	,0053	,01039	,00162	,0021	,0086	,00	,04
	3	28	,0019	,00426	,00080	,0003	,0036	,00	,02
	Total	89	,0033	,00767	,00081	,0017	,0049	,00	,04
nda00.rd	1	20	,0129	,02412	,00539	,0016	,0242	,00	,10
	2	40	,0458	,07691	,01216	,0212	,0704	,00	,40
	3	28	,0073	,01644	,00311	,0009	,0137	,00	,06
	Total	88	,0261	,05653	,00603	,0141	,0381	,00	,40
sales.nda00	1	19	1380,4070	854,89449	196,12625	968,3610	1792,4529	24,63	3233,82
	2	31	460,3039	717,04308	128,78474	197,2904	723,3174	20,77	3840,64
	3	7	62,7571	56,65607	21,41398	10,3590	115,1553	11,76	174,80
	Total	57	718,1834	866,02425	114,70771	488,3962	947,9706	11,76	3840,64

[39] Biotechs were included from the empirical analysis later on, which was not clear yet at the time of the interviews.

Glossary

Abbreviated new drug application (ANDA) – The application filed for approval of generic drugs by the US Food and Drug Administration (FDA). ANDAs require substantially less information than do new drug applications (NDAs) for prescription drugs, because applicants have to prove only that their products are identical (bioequivalent) to the brand products (Saftlas and Diller, 2006).

Active pharmaceutical ingredient (API) – A component of a drug that provides pharmacological activity and is important to the product's efficacy. The ability to get access to cheap, reliable APIs is an important competitive advantage for generics companies that do not make their own APIs (Saftlas and Diller, 2006).

Authorized generic – A generic version of a branded drug, made by the manufacturer or by a company that has been approved by the manufacturer. In essence, it is identical to the branded drug but has a different label. Innovator manufacturers use authorized generics to take some of the profits that are gained by generics companies from 180-day exclusivities (Saftlas and Diller, 2006).

Bioequivalence – Drugs that have the same rate and extent of absorption into the body when administered at the same dose and under similar conditions as described as bioequivalent. Bioequivalent products can be substituted for each other without a dosage adjustment to obtain the same therapeutic effect (Saftlas and Diller, 2006).

Biotechnology – Generally, biotechnology refers to any technological application that uses biological systems, living organism, or derivatives to make or modify products and processes. The approach differs from traditional drug development, which relies on synthetic chemistry and results in small-molecule, easy-to-administer treatments, and come in pills and tablets. Biotech products consist of larger molecules that are harder for the body to absorb and thus often have special administration requirements, such as injections (Saftlas and Diller, 2006).

Clinical trials – A series of carefully defined tests through which experimental drugs are administered to humans to determine their safety and efficacy (Saftlas and Diller, 2006).

Ethical drugs – Medicines requiring a doctor's prescription (Saftlas and Diller, 2006).

Generic drugs – A compound that contains the same active ingredients as a branded drug. A company cannot market a generic version of a rival's branded product until its patents expires (Saftlas and Diller, 2006).

Hatch-Waxman Act – A series of amendments to the Federal Food, Drug and Cosmetic Act (1984) that shortened the new generic drug approval process and provided for patent extensions on branded drugs; formally known as the Drug Price Competition and Patent Term Restoration Act (Saftlas and Diller, 2006).

Investigational new drug (IND) – An experimental new compound that has successfully completed animal studies and has been approved by the FDA to proceed to human trials (Saftlas and Diller, 2006).

New chemical entity (NCE) – A new molecular compound that has not yet received government approval for the use by humans. Excludes biologic compounds and vaccines (Saftlas and Diller, 2006).

New drug application (NDA) – The formal filing that drug makers submit to the FDA for approval to market new drugs. The documents must contain clinical evidence of the compound's safety and efficacy (Saftlas and Diller, 2006).

New molecular entity (NME) – An NCE or biological product, intended for use in a prescripition medicine, that has not received government approval for use in humans (Saftlas and Diller, 2006).

Orphan drug – A drug designed to treat rare diseases afflicting a relatively small patient population. The US government gives drugmakers special incentives to encourage the development of such drugs (Saftlas and Diller, 2006).

Over-the-counter (OTC) drugs – Compounds sold in pharmacies and other outlets without need of a prescription; also known as proprietary medications (Saftlas and Diller, 2006).

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